THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LIX. No. 1519.] LONDON, JUNE 21, 1892. [44TH YEAR. PRICE 6d.

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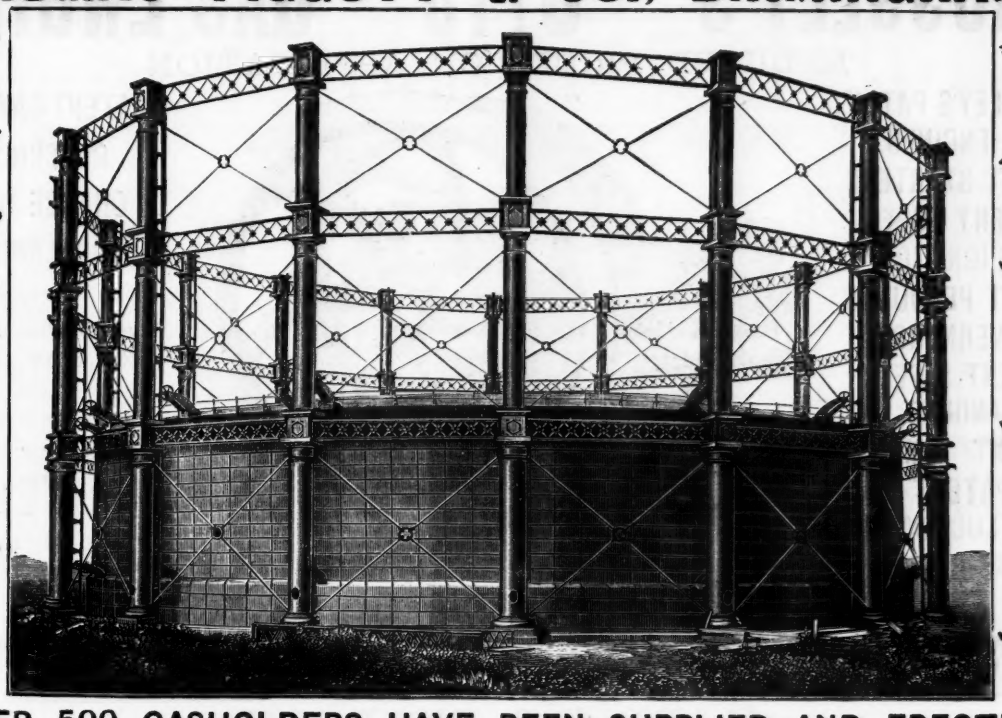

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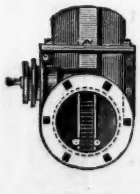

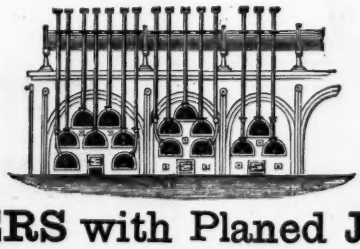

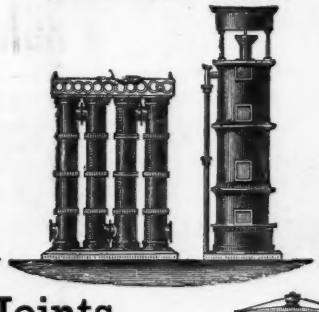

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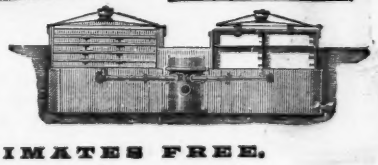

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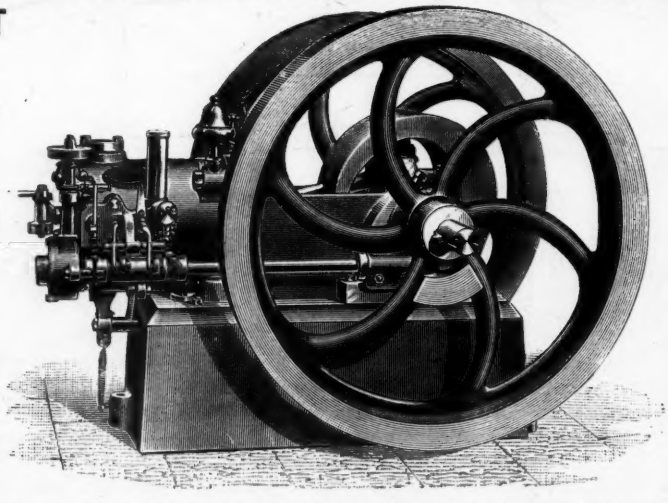

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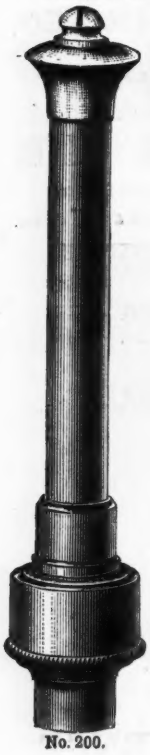

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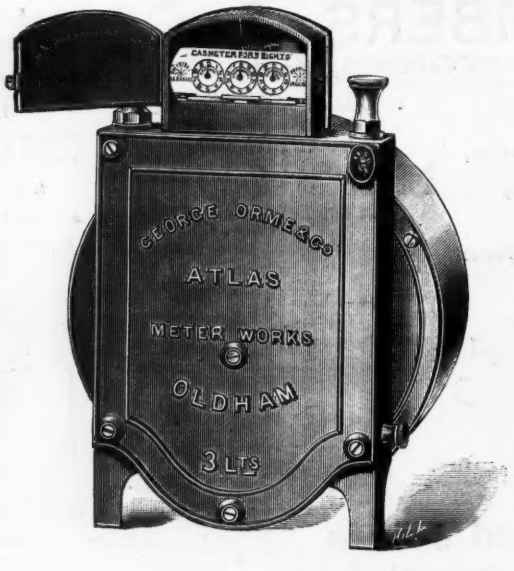
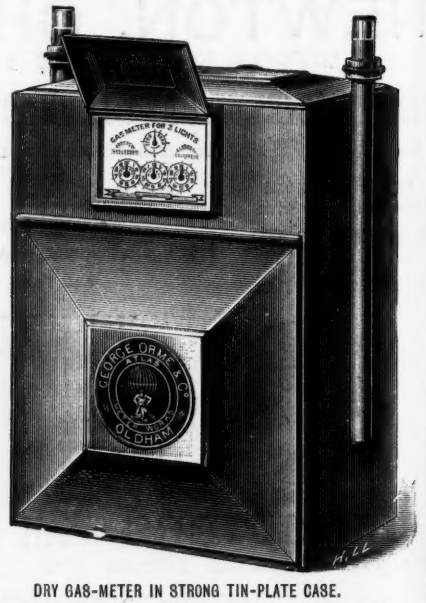


WET GAS-METER IN CAST-IRON CASE.



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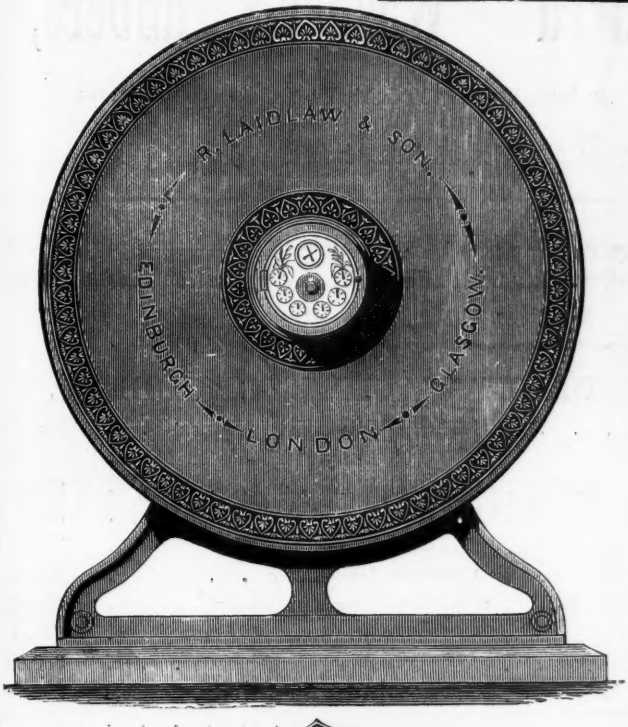

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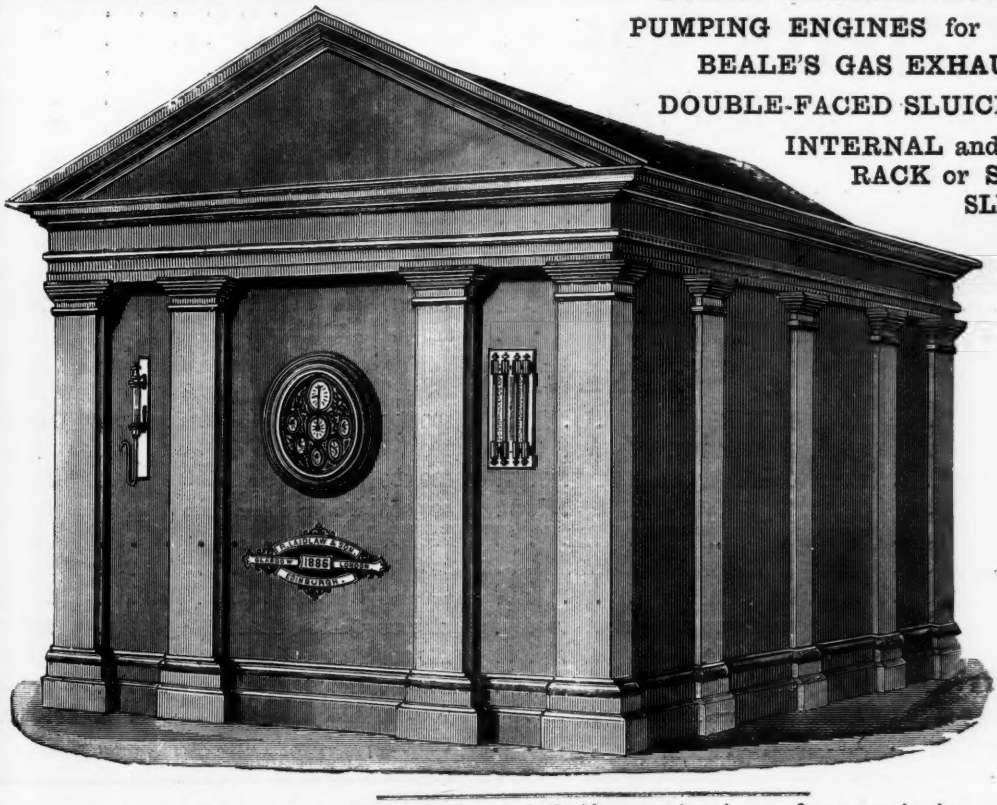

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,,	3,000,000	West Bromwich	1,000,000	Newton-le-Willows	500,000
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Croydon	3,000,000	Valencia (Spain)	875,000	St. Chamond (France)	350,000
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Charlottenburg (Germany)	1,500,000	,, ,,	600,000	Sydney	100,000
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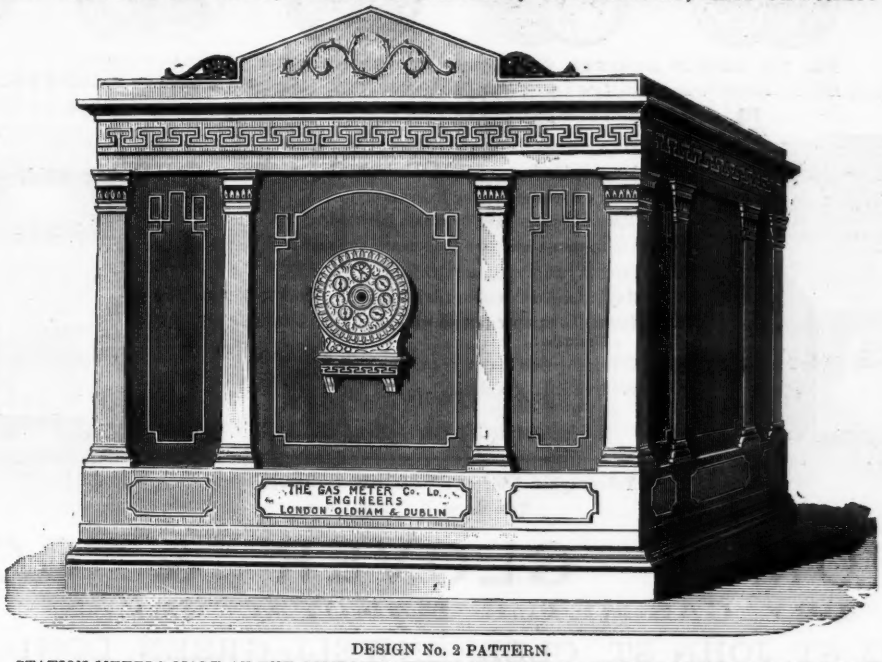

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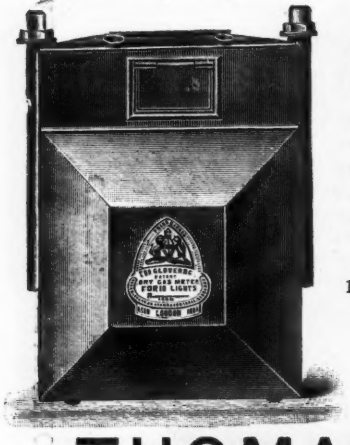

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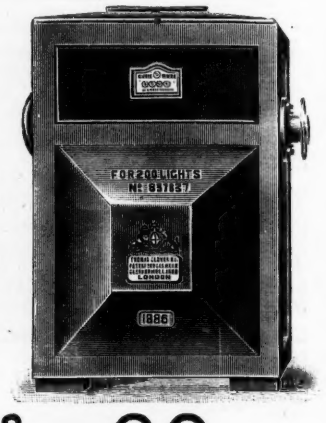

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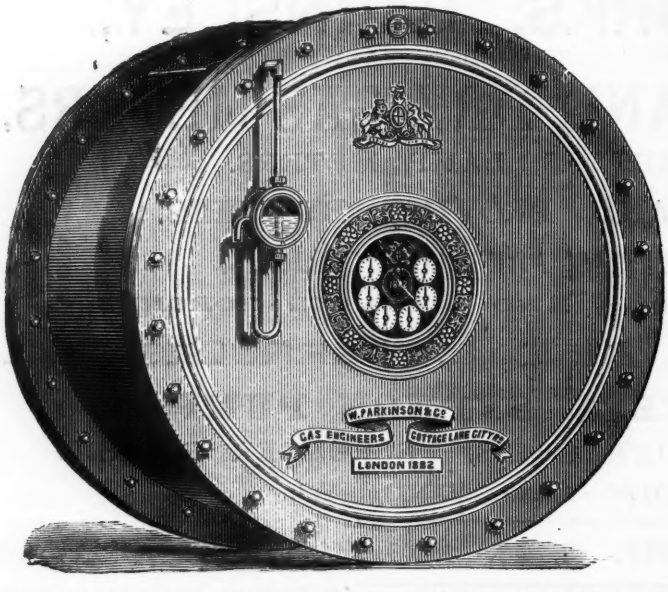

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JUNE 21, 1892.

The Gas Institute Meeting.

THE meeting of the Incorporated Gas Institute last week was in every respect an unequivocal success. The President—Mr. W. A. Valon, of Ramsgate and London—did more than was to have been expected of him as his official contribution to this result; the papers were, on the whole, distinctly good (and with the papers must be included, as a conspicuous part of the transactions, the Murdoch Lecture of Professor Lewes); the pleasure portions of the programme were well conceived and carried out; and, altogether, it is possible to rank the meeting of The Gas Institute for 1892 very high, if not absolutely at the top of all previous performances of the kind. We would not be misunderstood here; and therefore this remark necessitates some explanation. It is too true that the Institute, as an organization representing the British gas industry, no longer stands alone in the field. The wounds inflicted upon it by reckless selfishness, aggravated by unhappy treatment, are still uncicatrized; and it is impossible to say when, if ever, they are to be perfectly healed. But, regarded simply as a meeting of The Gas Institute, and neglecting for this purpose all reference to constitutional questions, we have no hesitation in describing that of last week as among the very best in the history of the organization. Even if the obviously personal efforts of the President are put aside, in order that the meeting should be judged by the conduct of the mass of the members who attended it, we can still characterize the gathering as of exceptional quality. Never were the attendances at the reading of papers so well maintained; and, since the once-notorious besetting weaknesses of the Institute must be referred to, it is with peculiar satisfaction that we are able to report an improvement all along the line which is little short of marvellous. In fact, the Institute appears to have "turned "over a new leaf;" and an impartial observer of the late meeting, who could also have recalled previous ones which need not be specified, would hardly have known the association for the same. Common justice demands that this acknowledgment should be made by us, who certainly have never shrunk from writing plainly about the Institute in the past.

Institutions and societies do not improve or degrade themselves, but are reflections of the personal characteristics of their members. The Institute has suffered sorely from circumstances. There has been a serious secession; and where there was once but a single organization of the kind, there are now two. For many reasons, this is deplorable; but a wise man takes things as they are—making the best of them. And so far as experience has gone, an observer who might wish to look on the bright side of this matter would have much reason for declaring that our two national technical organizations have put the members of each upon their mettle. Time alone can prove whether the gas industry is able to support two societies—a point upon which we cannot express an opinion; but it is possible to state that this year, at any rate, both have done very well. We were not prepared for the improvement for the better which has so conspicuously set in, in the case of The Gas Institute. There was the breaking of a gleam of hope for the Institute in the acceptance by Mr. Hepworth of the presidency for 1891; and the hearty way in which he was supported was indicative of the existence, among the majority of the regular supporters of the Institute, of a desire for the prevalence at their headquarters of the spirit of order, tempered with kindliness, and attuned to the steady performance of duty, of which the popular Carlisle engineer is the recognized embodiment. Mr. Hepworth had his trials, however, which he was very careful to put behind him, and say nothing about; but he had nevertheless to possess his soul in patience until such time as he should be able to clear the Institute of the worst *remanets* of the period of anarchy through which it had passed before coming into his hands. With Mr. Hepworth worked Mr. Valon in perfect sympathy, which was continued after the positions of the two men in the public eye had been changed by Mr. Valon's succession to the presidency. But whether it was one or the other who happened to be "on deck," the course followed was the same throughout the two years. This continuity of policy has had the happiest results for the Institute; and the appointment of Mr. Hepworth to the post of Honorary Secretary—which will not in his case be a sinecure—is the best guarantee that the policy identified with his name will be persevered in. Consequently, to the two last occupants of the presidential chair of the Institute must be ascribed a great deal of the credit for the change that has come over it. While saying this, we do not seek to ascribe to any one or two men, more than the

rest, the praise for that general turning towards the better way which was so patent in every aspect of last week's doings.

It is evident that the Institute does better in London than in a provincial town. When a large number of men get jumbled up together in a comparatively small place, any evil example that may be present has two deplorable effects—it corrupts some, and disgusts others who cannot keep out of the way. In the big manufacturing towns, moreover, generally affected by the Institute, there is literally no provision for rational recreation; and consequently a week of hotel life tells for the worse upon the weaker vessels among the members. In London, on the other hand, if there is "rowdyism"—which was happily absent last week—it is strictly localized. Why should it ever raise itself into prominence again? The same may be said of touting and treating. We cannot pretend to regard the choice of Belfast for next year's meeting as anything else than a mistake. It was done, mainly by men who had no acquaintance with the place, with the amiable intention of offering a compliment to the President-Elect, Mr. Denny Lane. But there is absolutely no real reason why the reviving strength of the Institute should be strained by holding a meeting in a place so far out of the way as Belfast is for all who do not happen to have easy access to the Lancashire coast. The attendance will not be good; the accommodation is certainly limited; and unless the members who will go to Belfast set themselves resolutely against a recrudescence of the mischief that has arisen upon former similar occasions, there will be danger lest a meeting that is likely to be tame in a technical sense may be even more unfortunate in others.

For there is another reflection to be made upon last week's performance. The Institute, having lost its front bench of debaters, and many others, is more dependent than its best friends would like to see it upon outside assistance for enduing its technical transactions with sterling interest. What would this year's book have been like without Professor Lewes and Mr. Walmisley? The members' papers were good average productions, but not very conspicuously above District Association form. The occurrence of Ascot races last week suggests a sporting analogy; and so we will put it that the proceedings of the Institute will not draw good meetings if they are to be all sweepstakes. There must be something added, if good sport is to be secured. Now, the Institute is fairly well off for funds, and London can always be depended upon for a few good professional lecturers and readers of papers. Something will have to be regularly done in this way—for a few years, at any rate—if the reports of the Institute meetings are to be worth reading, or the meetings themselves to be worth attending.

With regard to the important matter of recreation, the conspicuous success of the late meeting in this regard was due to two influences—the generosity and self-devotion of the President and Mrs. Valon, and the fact that the presence of ladies was invited, and even insisted upon as a feature. It is unnecessary to dilate upon the effects of changing the character of any assembly from that of a meeting of single men who are not exactly recluses, to that of a family gathering. In these days it is not needful to expound the right of women to play a more prominent part in most human affairs than was formerly assigned to them; and it appears to be an understanding that ladies are to figure more prominently than has hitherto been the case in connection with the meetings of The Gas Institute. If last week's experience is a reliable guide to a forecast of the consequences that may be looked for from this movement, it will result in nothing but good.

A Lesson from Ilkley.

THE Ilkley Local Board Bill has passed the House of Commons Committee on Police and Sanitary Regulations Bills. This statement may not appear at first sight to be of thrilling interest; and there are perhaps other localities of which it might be said that they take the eyes of Europe more particularly than the pretty district of the Ilkley Local Board. But appearances are deceptive, as more than one philosophical observer has ere now found occasion to remark; and there is a very cogent reason why readers of the JOURNAL, at any rate, should take heed of what has been done for Ilkley by the Commons Committee. The main object of the Bill promoted by the Local Board was to provide for the compulsory purchase of the undertaking of the Ilkley Gas Company, who for their part did not want to sell. Whenever transactions of this nature are in prospect, the interest widens beyond the parties immediately concerned, and takes in a large circle of those who feel that they may at any time be similarly circumstanced. The Ilkley district, though small, is a rapidly growing one. It is a favourite health-resort; and deservedly so. Consequently, the Local Board, which looks after the sanitary government of the place, realizes the need in its case of what would be called a progressive policy. Having provided various services for the population which they represent—such as water supply, a cemetery, and a cottage hospital—the Local Board cast longing eyes upon the Gas Company's undertaking, and made up their minds that they should like to possess it at its current value; thereby not only bagging the "increment" which the Company would otherwise inherit with the future growth of the district in gas-consuming capacity, but also possibly making a little money that would have been available for helping the rates.

It should be premised that the Company have statutory powers. In these circumstances, it is interesting to see how the Local Authority could make out a case for compelling the proprietors to part with their business. The first thing, of course, was to get up a case against the Company for mismanagement of their affairs and neglect to act up to the statutory requirements imposed upon them for the benefit of the consumers. Mr. Balfour Browne, Q.C., formulated a tremendous indictment against the management of the undertaking, the counts in which covered all the ground from the hours of employment of the lamplighters to the extension of the works out of revenue. Most of the local evidence offered by the promoters had reference to the smaller complaints such as could be paralleled in any locality, whether served by a gas company or by a local authority; but the Committee swept all that side of the case away, and devoted their attention to the financial question. This, as it happened, was the weakest point of the Company's position; for there was good ground for the suspicion that the books of the concern had been handled a little too cleverly. The evidence of Mr. T. Newbigging, which was corroborated by that of Mr. C. Gott, of Bradford, was full of strong expressions about the illegality of various payments which the Company had made to their reserve out of profits; and Mr. Newbigging also said that "a considerable amount had "been taken out of the pockets of the consumers for the "purpose of enlarging and extending the works." This sort of thing weighs heavily with a Committee; and in the case in point, Nemesis has come upon the Directors' sharp practices, in the shape of deprivation of their vested interest in the future gas supply of Ilkley. The Company will be fairly bought out; but the investment will be extinguished. There is a good moral in this story.

Mr. Fletcher's Annual Report.

IN the JOURNAL for the 7th inst., we gave a reproduction of as much of the annual report of the Chief Inspector under the Alkali Works Regulation Act as applies to the class of factories in which our readers are more especially interested. The manufacture of sulphate of ammonia is not a very fluctuating business, because the majority of those who engage in it do so for the sufficient reason that they cannot help themselves. The weight of sulphate coming into the market from factories unconnected with gas-works is growing year by year; but the whole of it is as yet not more than one-third of the output from gas-works proper. It is a curious result of the increasing use of the Claus sulphur-recovery process in ammonia and other factories, that the acidity of the chimney gases appears to be actually intensified thereby. Now, this is something to ponder over; because we so often hear assurances that, by the general adoption of waste-preventing devices, very much of the gaseous pollution of the atmosphere of towns, from which they now suffer so severely in various ways, would be entirely prevented. Well, here there is an economical waste-preventing arrangement, if ever there was one; and the net result is that it makes chimney gases worse than they were before. This follows, of course, because the process is not quite perfect; but experience shows us that it is just this last little objection to a manufacturing process which it is most hopeless to grapple with. A specially interesting portion

of Mr. Fletcher's report, in the estimation of many, will be that in which he discusses the question whether workers in sulphate factories are or are not exempt from attacks of epidemic influenza. It appears from statistics that there is something in the popular belief that men employed in this department of chemical industry are to some extent protected from this insidious malady; but it is always difficult to find exact figures capable of proving the reality of impressions of this kind. If, as is stated to be the case in some quarters, it is still doubtful whether there is anything in vaccination as a prophylactic against small-pox, how can the few statistics which Mr. Fletcher has been able to put together prove anything about the incompatibility between the influenza microbe, or whatever it is, and the air of a sulphate of ammonia factory? At all events, it is good to be assured that sulphate works do not increase the risk of influenza to workmen and dwellers in their vicinity; for so much has at different times been said and written against these factories, that, if Mr. Fletcher's evidence had pointed in a direction contrary to the result which he is able to draw from it, there would have been some danger of their being swept from the face of the land during some spasm of public nervousness.

A Repulse for the Socialistic Labour Party.

THERE will be little else talked about in this country for the next month or so but the General Election, the chances and changes of which will more or less affect every interest and individual in the community. For the time being, we are more particularly inclined to watch the proceedings of the Socialistic Labour Party, who are just now very busily and blatantly asserting their claim to the power of controlling the balance of the election in upwards of a hundred constituencies. Seeing that the result of a general parliamentary election in Great Britain depends upon the way in which a very small proportion of the electorate, computed to be not more than 5 per cent., choose to cast their votes, there is, on the face of it, some arithmetical justification for this boast. The party which can attract to itself this shifting proportion of voters must win. If one might judge by the noise they make, the Socialistic Labour group should constitute at least 5 per cent. of the electorate in many constituencies, and should therefore be able to turn a number of contested elections. The same claim might be made with exactly equal and similar justification, however, for numerous other well-defined groups of the voting community, with the necessary consequence that these independent sections of voters commonly neutralize one another; so that it is impossible for party managers to reckon with confidence upon winning through the support of any one of them. Hence the perplexity of the Socialist Labour leaders, who at one minute proclaim confidence in the effect of their mass meetings, and the next are made to feel that there is absolutely no real guarantee that the voting power which they are able to direct, after a fashion, will have the desired influence at the polls. These reflections strike one with peculiar force upon reading the newspaper reports of the recent remarkable interview between Mr. Gladstone and the leaders of the Socialistic Labour Party, when the latter desired to strike a bargain with the veteran statesman for the inclusion of the eight-hour demand in the Liberal programme, in return for their general support at the approaching elections. When he was first approached upon this point, as we know, Mr. Gladstone refused to even discuss the matter. Being constrained to think better of such a very uncompromising attitude, however, for reasons into which it is unnecessary here to go, Mr. Gladstone so far yielded as to receive a deputation from the London Trades Council, but the result left matters precisely where they were before. It is now as certain as anything connected with current politics can be, that the Eight-Hour Day men will have to deal as best they can with individual candidates for seats in the new Parliament. This of itself is tantamount to a defeat; for it leaves the candidates free to rely for their defence upon those insurmountable difficulties of detail of which nothing would have been said for a while, if the chiefs of either of the great parties had sanctioned the vague idea that the limitation of the hours of adult labour by legislation might be regarded as a point of modern statesmanship. Perhaps after the General Election we shall hear less about the Eight-Hour Legal Day than we have done of late, when it was at least "on the cards" that the propounders of the craze might find bidders for political support amenable to such offers as they were able to make.

Mr. G. Livesey's Evidence before the Labour Commission.—In the third line of the remarks appended to the table accompanying Mr. G. Livesey's evidence before the Labour Commission, as given in the JOURNAL last week, it should have been stated that the week's holiday with double pay after three years' service, granted to the South Metropolitan Gas Company's workmen in 1872, has been continued down to the present time.

The Automatic Gas-Meter Company, Limited.—By an advertisement which appears elsewhere, our readers will see that a Company has been formed, under the above title, to purchase and work the English patents of Messrs. Thorp, Marsh, and Haynes, relating to patent automatic attachments for application to ordinary gas-meters, to enable consumers to obtain gas in small quantities by the prepayment of a coin. The attachments are suitable alike for both wet and dry meters; and they can be affixed to any of the kinds now in use. We learn that meters constructed in accordance with the patents are giving entire satisfaction in Liverpool, where a number of them have stood the test of more than a year's work. The capital of the Company is £50,000, in £5 shares; the present issue being £20,000. The purchase price of the several patentees' interests is £10,000, payable half in cash and half in shares, or the whole in cash, at the option of the Directors. The subscription list will open to-morrow, and close on the 28th inst.

The Late Mr. G. Shepard Page.—In the course of his Inaugural Address at the meeting of The Gas Institute last week, the President alluded to the late Mr. George Shepard Page, whose sudden death on the 26th of March was recorded in the JOURNAL at the time. In connection with Mr. Valon's remarks, a few particulars as to the career of the deceased, taken from the *American Gaslight Journal*, may not be uninteresting. Mr. Page was born at Readfield (Me.), in 1839; and at the age of eight he was taken by his parents to Chelsea (Mass.), where his father had started works for the distillation of paraffin. In the High School of that town he received his education; graduating there about the year 1857. Subsequently he joined his father in the special industry in which he was engaged, and which rapidly assumed importance. Mr. Page, however, turned his attention to the treatment on a large scale of the tar produced in gas-works; and to this end he went to New York about the year 1860, and established himself in this business. At the close of the War he was a member of the firm of Messrs. Page, Kidder, and Fletcher, which was afterwards converted into a joint-stock undertaking, having the title of the New York Chemical Company. On the occasion of a visit to Europe about twelve years ago, he was much impressed with the practice prevailing here of treating ammoniacal liquor; and he was successful in inducing American gas managers to take up the work. The result has been specially valuable to the gas industry. The late Mr. Page was a member of the American, Western, and Ohio Gas Associations, and also an associate of The Gas Institute.

A New Sand-Washing Apparatus.—In the first number of the JOURNAL for the present year we noticed the sand washing and elevating machine devised by Mr. Greenway, and constructed by Messrs. J. Gibb and Co., of Fenchurch Street. An appliance having a similar object has been brought out by Messrs. Hunter, Fraser, and Goodman, and has been put in operation at the Kew Bridge works of the Grand Junction Water Company, under the supervision of the Engineer (Mr. A. Fraser, M.Inst.C.E.). The new apparatus consists of a receiver, which is placed at the level of the filter-bed, and into which the sand is tipped from barrows. From the receiver the sand, mixed with water, is carried up a tube to the first of a series of hoppers on the bank of the filter-bed by means of an injector supplied with water. The hoppers are of cast iron, and are placed about 7 feet apart. Each hopper is 2ft. 4in. square, and 2ft. 2in. high over all, and is provided with a jet-pipe connected with a main carrying water under pressure, and regulated by a valve. When in operation, the water is turned on, and issues through each jet—forcing water up the delivery-pipes into the hopper; the valves being so regulated as to give a uniform overflow at each hopper. The dirty sand is delivered into the first hopper of the series, and, gravitating to the bottom, is carried forward in a mixed stream of water and sand into the next hopper. This process is repeated in each hopper until the last in the series is reached, which discharges the clean sand into a truck on the filter-bed for relaying there or at any other point where it is wished to deliver it. The dirt is thoroughly separated from the sand, and passes away from the hopper with the overflow water. With a moderate consumption of water, two men can wash and screen 3 cubic yards of sand per hour, no matter how dirty the sand may be. There are two sets of the apparatus at the Kew works, where they have been in satisfactory use for the last six months. One set cleans the whole of the sand of a filter-bed nearly 2 acres in area; while another set is at work cleaning the surface sand of a filter-bed ¾ acre in extent. Mr. Fraser states that under the old system the thorough cleansing of the sand of the larger bed cost about £2000; while by the new system it is more quickly effected for about £1000.

WATER AND SANITARY AFFAIRS.

On resuming their sittings at the commencement of last week, the Metropolitan Water Supply Commissioners plunged into a sea of statistics, with very little prospect of achieving any great practical result. Mr. Binnie, the Chief Engineer of the London County Council, went so far as to say that all the returns made to the Water Examiner by the Companies had been "knowingly incorrect." The President of the Commission very properly interposed with the remark that it was quite likely there might be some misunderstanding in regard to the particulars; but his Lordship signified that the Commissioners desired, if possible, to conduct the inquiry "without any allegations of knowingly false "returns." Unless Mr. Binnie exempted the East Loondn Water Company from his censure, it is difficult to understand his subsequent allusion to "his friend Mr. Bryan," who, as the Company's Engineer, would be directly responsible for the return made concerning the quantity of water pumped. With regard to the population, no doubt there is some degree of difficulty in getting an absolutely correct estimate. In the returns made to the Registrar-General by the Water Companies, instead of announcing the "Number of houses, &c., supplied," we now read "Number of services." Of course "houses" may form the basis for estimating the population; but "services" and "houses" may not be quite synonymous. If the Companies have over-estimated the supply, so also they may have over-estimated the population. In the year 1890 they only credited themselves with giving an average daily supply of about 31 gallons per head. Mr. Binnie reckons that they must be supplying more than this. If so, we do not see that it redounds to their discredit. Mr. Binnie is sceptical. With regard to the abstraction of a certain quantity of water from the Thames by the Companies "under agreement," he signified that he was not prepared to believe in the existence of such an agreement until it was produced. The President happily settled this point by saying "the Commission had "been furnished with a copy." Mr. Binnie thereupon proceeded to quarrel with the agreement, as giving the Companies power to draw more water than their several Acts of Parliament allowed. On this subject some interesting evidence was afterwards given by Mr. J. H. Gough, the Secretary to the Thames Conservancy; showing, among other particulars, that the Companies were more free than might be supposed, and the Conservators were not restrained in any way by their own Acts from granting an additional supply of water. As the water was wanted, unprejudiced persons will admit that it was well it should be supplied; and the Conservators might be trusted to guard the river from being immoderately drawn upon.

Three half-yearly meetings were held among the London Water Companies last week. In all cases the speeches from the chair were hopeful in tone; confidence being expressed as to the result which might be expected from the inquiry in progress by the Royal Commission. There was also an assurance that Parliament would give the Companies fair terms in any transfer that might take place. The purchase of the Accrington undertaking (noticed in another column) was referred to as a case in which an equitable price had been obtained. At the Grand Junction meeting, the final relinquishment of the Dorney scheme was announced. The history of that affair says little for the wisdom of the House of Commons, which rejected a valuable project without condescending to inquire into its merits. At the Chelsea meeting, Sir W. H. Wyatt congratulated his hearers on the refusal of Parliament to constitute the County Council the Water Authority for the Metropolis. Sir H. E. Knight, at the meeting of the Southwark and Vauxhall Company, in referring to the Royal Commission, evidently had Mr. Binnie in mind, when claiming for the advisers and officials of the Water Companies a more intimate acquaintance with the facts involved in the inquiry than could be arrived at by outsiders, who simply picked up their information from published statistics. Coupled with these encouraging speeches, there was the declaration of satisfactory dividends. The Companies are in full vigour, despite all the attacks that have been made upon them, and are quite prepared to let their case stand upon its merits.

Sir William Harcourt appears anxious to escape the responsibility of having been the chief actor in bringing about the rejection of the Metropolis Water-Works Purchase Bill of 1880. It was not he who did the deed, it was the Corporation of London and the Metropolitan Board; and he charges Mr. A. J. Balfour with "absolute "ignorance" in regard to this very matter for having said: "I am a member of the party which attempted, "twelve years ago, to give the water supply to "London, but was foiled by the machinations of Sir "William Harcourt." In a letter sent to Mr. Causton, M.P., on Thursday last, Sir W. Harcourt argues that the terms of purchase proposed by Sir Richard Cross were absolutely and decisively condemned by the Select Committee appointed to inquire into the subject. Of that Committee Sir W. Harcourt was Chairman; and if Mr. E. J. Smith, who negotiated the terms of purchase, were alive, he would be in a position to say something respecting the kind of treatment which he, as the leading witness in support of the scheme, received from the Chairman. Of the determined opposition of Sir William to the provisional agreements which had been entered into, there can be no doubt. The spirit of the most vehement partisanship appeared to govern all his proceedings with respect to this matter; and the same feeling is displayed in the letter to Mr. Causton. We are told of "the reckless and ruinous agreements" which Sir Richard Cross had contracted; and it is asserted that the stipulated payments "would have entailed a heavy loss on "the London ratepayers." Perhaps it will not be amiss to refer to a parliamentary return issued in 1885, in which Mr. Allen Stoneham, the Government Auditor, shows that, down to the close of 1884, the excess of earnings by the Companies over the annual interest allowed to them by Mr. Smith was close upon £100,000, in addition to which the balances of cash which were to have been handed over by the Companies amounted to about £300,000. This, again, was independent of any saving in working expenses which would have been effected by the abolition of Directors, the consolidation of the staff, and the more economical disposition of engine power. There can be no doubt that party tactics had much to do with the opposition raised against the scheme. Since that period a calmer judgment has been exercised, and a growing conviction has arisen that in 1880 a grand opportunity was lost for placing the water supply in charge of a public trust. A significant passage in Sir W. Harcourt's present manifesto is that where he says that the possession of authority for the introduction of an independent water supply "is indispensable to dealing with the Companies on "reasonable terms." In like manner we find the *Pall Mall Gazette* saying, in reference to the provisions retained in the London Water Bill: "The duty of preparing a scheme "for the supply of water to the Metropolis is now thrown "upon the London County Council." But what if the Royal Commissioners report by-and-bye that no such scheme is necessary?

Received.—"Everybody's Pocket Cyclopædia" (Saxon and Co., 23, Bouverie Street, E.C.); a useful little collection of "things worth knowing and difficult to remember," which has reached its 510th thousand. Mr. T. Fletcher, F.C.S., has forwarded to us a copy of the fourth edition of his "Coal Gas as a Fuel—A Concise Guide to Fitters and Users." The size of the book has been reduced, so as to allow of its being carried in the pocket

A Memento of Murdoch.—A few weeks ago we noticed at some length the interesting sketch of the life of William Murdoch which his grandson, Mr. A. Murdoch, of Pollokshields, has published in view of the approaching celebration of the centenary of gas lighting by the North British Association of Gas Managers. A memento of the early days of the industry which Murdoch did so much to create has just come to hand in the shape of a *fac-simile* reprint of a letter he addressed to a Member of Parliament, in vindication of his character and claims, in reply to a publication by the Committee who were conducting through Parliament a Bill for incorporating The Gaslight and Coke Company. Murdoch, it seems, was particularly annoyed at an insinuation that he had been anticipated by one Diller, a Dutch or a German chemist, of whom he had never heard; and he presented a petition against the Bill. He was represented before the Committee by no less a person than Brougham; though he did not, as is generally supposed, give evidence. The Bill was rejected; but another received the Royal Assent in the next session. The letter, which is dated May 4, 1809, is accompanied by a prefatory note by Mr. R. B. Prosser, of 75, Dartmouth Park Road, N.W., to whose enterprise the interesting reprint is due.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE TWENTY-NINTH ANNUAL GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS, JUNE 14, 15, & 16, 1892.

Mr. W. A. VALON, Assoc.M.Inst.C.E., President.

REVIEW OF PROCEEDINGS.

ALTHOUGH the hour of opening the annual meeting of the Incorporated Gas Institute had been considerately fixed for eleven a.m. on Tuesday last, there was a by no means large attendance of members in the lecture theatre of the Institution of Civil Engineers when, punctual to the minute, Mr. W. A. Valon, of Ramsgate and London, the President for the year, took the chair, and, with praiseworthy despatch, entered at once upon the business of the meeting. The intelligence of the President's arrival, however, quickly permeated through the building and its precincts; and the hall soon showed the full strength of a gathering that, albeit not perhaps among the largest in the history of the Institute, afterwards proved to be one of the most regular in its attendances for the transaction of business.

Mr. Valon was well received; and the meeting soon gave it to be understood that the Chair would be supported in clearing the programme with celerity and good humour. During the pause which, as usual, accentuated the sacrifice of a couple of members in the cause of the scrutineership of the voting-papers, the first "incident" of the meeting occurred in the appearance of Mr. William Carr, late of Johannesburg and some time of Halifax, whose entry was greeted with a welcome that to its subject must have made some amends for a great deal of unpleasant experience of the ways of men and the highways of the world.

The reading of the report of the Council by the Secretary (Mr. W. H. Harvey, B.A.) did not call forth any comment, although by this time it must have been borne in upon members that, in order to preserve the Institute in its present position, to say nothing about any expansion of its work in the future, a tight hand will have to be kept upon the revenue. It is well to be able to remark that the mention made in the report of the late Secretary, Mr. W. H. Bennett, was sympathetically greeted. In moving the adoption of the report, the President made a full statement relative to the part taken by the Council, in the name of the Institute, in bringing certain views of subjects connected with the photometry of gas before the Board of Trade Committee on Standards of Light. This matter was afterwards dealt with again; but it will be convenient to conclude our references to it here. It appears that the Council of the Institute have been laudably anxious to do as much as lay in their power to deprecate any action by the Committee that might prejudicially affect the gas industry throughout the country. They have recognized as inevitable not only the disestablishment of the candle as the legal standard for gas testing, but also its substitution by a pentane standard; and while willing, in agreement with the Incorporated Institution of Gas Engineers, to accept a pentane representation of the old candle unit, or some convenient multiple thereof, as satisfactory to the interests which they represent, they are reluctant to consent to any other radical alteration of the methods by which the photometry of gas has hitherto been carried out. The position of the individual members of the Committee of the Council who have had this particular matter in hand was fairly explained on Thursday morning, when an opportunity was afforded to the meeting, by the kindness of Mr. Sugg, of seeing a 10-candle pentane-air standard flame, and of following the considerations that have resulted in the suggestion of this method of applying the principle of Mr. Vernon Harcourt's proposed substitute for candles. No discussion of the action of the Committee of the Council was taken—the business being treated as still in committee; but the members present enjoyed the privilege of being made better acquainted with the uses and advantages of pentane than could have been done in any other way.

After this semi-confidential business had been disposed of for the time being on Tuesday, the satisfactory intimation was made that the Royal Commission on Labour had accorded permission for the inclusion of the statement relative to the condition of labour in the gas industry, which had been submitted to the Commission by the President (as reported in the JOURNAL a fortnight ago) in the printed Transactions of the Institute for this year. This is an important concession, and one that should result in great good to the industry at large. It cannot be denied that some of Mr. Valon's returns showed the existence in some parts of the Kingdom of room for considerable improvement in the conditions of gas workers; and it is undesirable that the good reputation of the best class of gas-works should suffer from the unfavourable and backward state of others in this regard.

Then came the presentation of the Birmingham Medal to Dr. Perkin, the discoverer of the colouring principle in coal-tar derivatives. The President made the presentation with a graceful speech, briefly recounting the nature of Dr. Perkin's splendid services to modern material civilization; and he followed up this historic incident in the record of the Institute by similarly bestowing the President's Medal for 1891 upon Professor Vivian B. Lewes, F.I.C., F.C.S., who thus, in the most favourable circumstances, made his first appearance at a meeting which before its close was destined to become better acquainted with the new Chief Gas Examiner for the City of London, and to recognize in him one of the most powerful of living agents for the advancement of precise knowledge in the science with which the members are closely identified.

Having thus cleared away all the preliminary work, the President rose at 11.35 to perform his chief public duty to the Institute by reading his Inaugural Address, the text of which we gave in last week's JOURNAL.

The address began with the usual references to the report of the Council, for the purpose of mentioning once more, in the ears of the assembly which knew their forms in the flesh, the names of those once prominent members and friends of the Institute who have "joined the majority" since the last meeting. From this imperative but mournful courtesy to the departed, the President passed to a very lively subject indeed—the Chicago Exhibition of next year; and he took the opportunity of notifying his intention of attending this great industrial gathering on the shore of Lake Michigan. As Mr. Valon remarked, the official representative for exhibition purposes of the gas industry of the United States—Mr. Alex. C. Humphreys—and his colleagues, will be only too pleased to welcome to Chicago any British gas engineers who can make the pilgrimage; and whoever does so will doubtless return with a mind broadened and deepened by the fresh knowledge of men and things which is the peculiar fruit of travel. At the same time it is only right to state, with regard to some of Mr. Valon's observations relating to the part which the American gas industry may be expected to play at the Exhibition, that it is by no means certain as yet that Mr. Humphreys' "Gas Industry Council" will be able to carry out their programme. Their appeal for funds to build a "gas house" and to make a respectable showing for the national gas industry has not been very successful up to the present. Consequently, it will not be surprising if they leave the industry to shift for itself.

Proceeding to discuss the regular presidential topic of the general progress of gas manufacture and utilization, Mr. Valon wisely insisted upon the truth that in an established industry, such as that of gas supply, it is the aggregate of small improvements that constitutes real progress. While it is true in one sense that coal gas is made in much the same way to-day as fifty years ago, it is equally true that a modern gas-works is a factory differing in almost every particular—of design, scale, construction, administration, and working—from anything that went by the same name during the early years of Her Majesty's reign. We have often remarked upon the difficulty of formulating in precise phrases the nature and extent of the improvements in gas manufacture which mark the passing of successive years; and perhaps, for all its vagueness, the test, suggested in the address, of the "feeling that from time to time advancement has been surely made," is as good a guide as we can have.

Descending from the general to the particular, the

President went on to express his views respecting the employment of labour-saving machinery in gas-works. He laid down, in the most uncompromising fashion, the principle that machines for working horizontal retorts, albeit not yet perfect, are now good enough for every gas manager to make use of to the full extent of his needs and opportunities; and he declared that the engineer who neglects to take advantage of this class of machinery incurs a heavy and needless responsibility. As for the revived fashion of sloping retorts, suffice it to say that Mr. Valon regards their advantage as "not proven." With respect to the other retort-house matters dealt with in the address, it appears that the President includes gaseous firing, self-sealing lids, screened foul mains, and liquor seal for the dip-pipes, as contributories to the general advancement of carbonizing practice which has been effected during the last decade or so. Mr. Valon's interest in retort-furnace construction is well known; and it would have been more than human in him if he had refrained from all mention of the success of the style of gas-generator design with which his name is so closely identified. To do him justice, however, he made no vaunt of this, but took the occasion to enunciate some guiding principles for economical furnace arrangement which have been deduced from his own experiences.

Leaving carbonization and treating of purification, Mr. Valon insisted upon the importance of proper treatment of gas before it leaves the washer. He pointed out that while the tar should be removed as quickly as possible from the crude gas, its temperature should be lowered slowly. He also laid great stress upon the necessity of avoiding over-washing the gas, and showed the desirability of allowing it to retain a little ammonia up to its entry into the purifiers. As to purification, the President declared that there are only two systems (by which, of course, he meant good systems, really worth talking about) in the field—one being the Claus ammonia process, and the other the oxygen method of working dry boxes continuously. Some perusers of the address will say that this is a very sweeping way of stating the case. Neither is it quite correct to characterize the use of air in purifier working as an "offshoot" of the pure oxygen method. It would have been more accurate, as well as more conciliatory of objectors and disbelievers who are still a majority, if Mr. Valon had described the oxygen process, which owes so much to himself, as a refinement upon the older air process, and also an improvement in respect of efficiency and economy. For all that Mr. Valon can say, it is certain that only a small fraction of the coal gas made in the United Kingdom (to leave the rest of the world out of the count) is as yet purified by the help of pure oxygen. It may be true, as he would contend, that the misguided individuals who prefer to jog along with 1 per cent or so of air, or with none at all, instead of using oxygen, are guilty of the blunder of making shift with a poor device when they could have a better for the asking. But while they exist in such respectable (if not overwhelming) numbers, they must be reasoned with patiently and gently, if they are to be convinced of the error of their ways. Mr. Valon is of opinion that the apparent cheapness of the air system is illusory, inasmuch as it has to be paid for by a diminished illuminating power. This is true, so far as it goes. Fortunately, or unfortunately, according to the side from which the view is taken, the truth under consideration does not possess the same monetary value everywhere. We do not speak now of prejudice and obstinacy, which only too often resist the entry of true teaching from an unwelcome source. The point is this: Where every grain of sperm in the gas is precious, as it is with the London Gas Companies, or any other makers tested daily up to the extreme illuminating power of the coal at their command, it would be a piece of idiotcy to admit even the 1 per cent. of air which would be necessary to do the slightest good with the air process. Where, however, the standard illuminating power required is only 14 candles, whereas the coal used is capable of yielding gas of 15½ candle power, or even more when the carbonic acid is taken care of, it becomes a question with the manager whether he might not just as well sacrifice the extra half candle, and take in as much air as he wants, as lay down oxygen plant. And the residual nitrogen goes through the meters with the rest. We are not pronouncing any opinion upon the controversy between the partisans of the air and oxygen processes of gas purification. Time will show who is right in these matters; and, in the meanwhile, there cannot be too much discussion respecting the points at issue.

The address next dealt with the disposal of coke, and the influence of smokeless fuel upon the air of towns. Mr. John Aitken's researches upon atmospheric dust were alluded to; and it seemed to be the President's object, in this portion of his oration, to remind his hearers that, while the burning of coke and gaseous fuel in towns afflicted with fogs might be expected to relieve the blackness of these visitations, this expedient would not prevent their formation. It is by no means universally agreed, however, that the sulphur resulting from the combustion of coal, coke, and gas is, as observed in the address, of real antiseptic value. What Mr. Valon had to say about gas-burners was very brief. He remarked of the regenerative principle in this connection that it has done all, or nearly all, that can be expected of it; and he looks to the incandescent principle as offering greater possibilities of improvement in developing the luminous value of gas.

The President evidently intended his references to the question of oil gas, &c., to be a leading feature of his address. Presumably on account of not having himself been able to experiment exhaustively upon water gas and the gasification of oil, Mr. Valon has sounded several American authorities on the subject. It is not to be supposed that Mr. A. C. Humphreys told him all the secret of the extended use of water gas in the United States, which is largely due to artificial causes. But whether he obtained his information from this or from other sources, it is clear that the President has formed a very positive opinion as to the system by which oil gas can best be made in this country, if it is to be made at all. After all, however, the Gas Engineer of the Ramsgate Corporation speaks mainly as a representative of the class of gas managers for whom carburetting methods have only a theoretical interest.

Another, and indeed *the* leading feature of the address, was the President's account of the work undertaken by himself and the Secretary for the Royal Commission on Labour. We have so recently commented upon the evidence tendered before the Commission by Mr. Valon, that it is unnecessary to follow him again through the second edition of the same material which he laid before the members of The Gas Institute. Neither before the Commission nor the Institute did Mr. Valon freely speak his mind respecting all the facts of employment in gas-works elicited by his circular inquiries. Reading between the lines of the presidential remarks upon certain of the returns to his questions, we incline to think that he would like, if he could do so, to recommend to the management of factories that are below the average to "close up" before a worse thing happens to them. When we hear of yard labourers and mechanics working 72 and 84 hours per week, and stokers working up to 90 hours per week, it is enough to explain the vitality of some branches of the Gas Workers' Union. We say here deliberately that if this Union had only attended to these benighted places, instead of wasting its strength in impotent enmity to the most enlightened employers of the age, we should have wished it every success.

Lastly, the President uttered a timely and vigorous protest against the miserable and ruinous way in which some controllers of gas undertakings cut down the standard of remuneration for the discharge of the duties of gas management, and so do their best to drive honest, capable, self-respecting men out of the profession. It is quite true that some gas directors and committees of local authorities expect all the virtues and talents in a gas manager, for a recompense at which a keeper of a beershop would turn up his nose. Of course, they must suffer in the long run; but they have not the wisdom to see this. "Penny wise and pound foolish" is the way with these people; and so it will be to the end of the chapter. Well, since there is no evil without some compensating good, so in this regard, the small remainder of capable men who happen to be appreciated according to their deserts will reap a fine harvest of fees for setting right the blunders of the "cheap-and-nasty" class; and the consumer and the ratepayer will pay for all, and be none the wiser.

The address was particularly well received. Couched throughout in a style which made no pretension to oratorical effect, every sentence it contained was well within the comprehension of the whole audience, who followed

the speaker throughout with that attention which is more gratifying than bursts of applause—which, however, came without stint at its close. It cannot be said that Mr. Valon earned his triumph by seeking to be popular and pleasing at all costs; indeed, he said a good deal that would doubtless have been sharply criticized in the writer of a paper. But his remarks were sincere, and to the point. Long as the address was, it maintained its interest to the end, because it was instinct with individuality, and was absolutely devoid of padding. If we may still further summarize the presidential utterance, it must be to remark that the portions which seemed to make the most distinct impression during the delivery, and to call for more special study afterwards, were those relating to retort-house work, purification, and the position of men and officers in the gas industry. It cannot be gainsaid that the address was a conspicuous and deserved success. And here we would also say that, if Mr. Valon proclaimed his personality with much force in his address, he effaced himself with rare self-denial afterwards; for not in commenting upon any of the papers did he indulge in those official criticisms of an encyclopædic cast to which some occupants of presidential chairs are prone. He did not, in short, assume the professor; but was content to be the businesslike president.

We shall not now attempt to criticize the papers read at the meeting. Suffice it to acknowledge fully and freely that, with small exception, they were all of a good and even of a high class. The meeting was characterized by exemplary industry; and never in the history of the Institute have the morning and afternoon attendances for the three days of solid work been better maintained.

The second day was, to all intents and purposes, a time of triumph for Professor Lewes, whose Murdoch Lecture fairly carried away the meeting, which had had no previous experience of Professor Lewes's masterly style of exposition. Given without a note and without a pause, and illustrated with experiments and diagrams as suggestive as they were informing, the Murdoch Lecture enhanced the brilliant reputation that Professor Lewes gained by his Cantor Lectures. It is unnecessary to say more.

Wednesday night was marked by a most successful Presidential Reception of members and friends of the Institute at the Westminster Town Hall. To Mr. Valon's hospitality the Institute owes one of the most enjoyable social "functions" recorded in its history; and he has the gratification of knowing that his generous effort to add to the pleasure as well as to organize the instruction of the meeting of 1892 was appreciated as fully as it deserved. It would be idle to attempt to conceal the fact that Mr. Valon had set himself the by no means easy task of rehabilitating the Institute in a position which circumstances had made difficult, almost to hopelessness, of re-attainment. But all that infinite pains, unstinted labour, and unobtrusive liberality could do towards affecting this end, was ungrudgingly given by Mr. Valon; and the fitting reward was not withheld. After all that it has gone through, it would indeed be churlish to deny to the last two Presidents of the Institute—Mr. Hepworth and Mr. Valon—an unstinted meed of praise for the public spirit which both have manifested in doing what they conceived to be their duty to the colleagues who put them in the position where they came under the responsibility of saving for good an organization which, we do not hesitate to say, would in any other available hands have been irretrievably lost. Much yet remains to be done before the Institute can be regarded as relieved from all danger; and the record of the latest Presidents will not be without the drawback, inherent in exceptional performance, of throwing a heavy burden on future incumbents of the presidential office. But, bearing in mind the deplorable consequences that personal errors have entailed upon the Institute in the past, we cannot conscientiously refrain from bearing testimony to the good effect of meritorious conduct in its service in the contemporary period which dawned, let us say, at Carlisle, and has culminated in this London gathering.

Thursday, also, was a day of good record, thanks principally to Mr. A. T. Walmisley, who showed what trained engineering and mathematical aptitude can do for the elucidation of some problems of gas-works construction, and whose contribution to the literature of the meeting was a worthy pendant to that of the previous day's doings. We have already mentioned Mr. Sugg's interesting demonstration of the capabilities of pentane for the production of an acceptable photometric standard. To Mr. B. H. Thwaite, also, should be awarded well-deserved praise for an exhibition and description of the most modern improvements in calorimetry and pyrometry.

The election of Mr. Denny Lane as President, and the selection of Belfast as the place of meeting for next year, were very popular. The announcement that Mr. Hepworth would be retained for the service of the Institute, by virtue of his acceptance of the office of Honorary Secretary, was received with enthusiastic approval, as well it might be. It is the very best thing that could have happened for the Institute. The day closed with a visit to the Goswell Road distributing station of The Gaslight and Coke Company, under the direction of Mr. G. F. L. Foulger, newly elected a member of the Council. And so the business portion of the 1892 meeting of The Gas Institute concluded, to the general satisfaction, which was well expressed by the veteran Mr. George Anderson, who, indeed, went to the length of declaring it to have been the most successful in its history. Even if something must be taken off from this statement, to allow for the perfervid *ingenium Scotorum* of the speaker, the response which it evoked showed that it very fairly represented the opinion of the meeting.

The excursion to Windsor and the Upper Thames on Friday was extremely popular, and was completely carried out according to the arrangements made by Mr. Harvey, the painstaking Secretary.

REPORT OF PROCEEDINGS.

The Twenty-ninth Annual General Meeting of The Gas Institute was held on Tuesday, Wednesday, and Thursday of last week, at the Institution of Civil Engineers, Great George Street, Westminster, under the presidency of Mr. W. A. Valon, Assoc.M.Inst.C.E.

The minutes of the last annual meeting were taken as read.

Appointment of Scrutineers.

Mr. J. W. Glover (Chelsea) and Mr. J. Whyte (Seaham Harbour) were appointed Scrutineers of the ballot papers.

Annual Report—Standards of Light.

The Secretary (Mr. W. H. Harvey, B.A.) then read the annual report of the Council, the principal portions of which were given in the Journal last week.

The President, in moving the adoption of the report, said: There is another matter on which I ought to say a few words, in order to make the account of the year's work complete. It has occurred too recently to be referred to in the report now before the meeting; and therefore a few supplementary remarks are perhaps advisable and necessary. As you are all aware, a Committee on Photometric Standards, under the chairmanship of Dr. Odling, has lately been appointed by the Board of Trade, for the purpose of collecting evidence, and, I presume, of making recommendations, respecting that matter so important to the gas industry—the standards of light. On the 10th of May last, the Committee invited the Council of the Institute to select two or three representatives to appear before them on the 2nd of June; and they suggested that they should confer beforehand with three representatives of the Incorporated Institution of Gas Engineers, who were also to attend on that date, in order to decide on the form the recommendation should take. Although the notice given was very short, the importance of the matter was felt to be so great as to warrant a prompt effort being made to meet the wishes of the Committee. The views of the Council having been ascertained by circular, three of their members—Mr. John West (Vice-President), Mr. Norton H. Humphrys (ordinary member of the Council), and myself—were selected as representatives to confer with the representatives of the Incorporated Institution of Gas Engineers, and to appear before the Standards of Light Committee. On the 2nd of June, your Council's representatives met, and agreed upon the following two general resolutions:—

(1) That the opinion be strongly impressed on the Committee on Photometric Standards that no standard will be acceptable to the gas industry generally unless based upon, and of the same relative value as, the existing parliamentary standard candle or unit of light.

(2) The representatives of the Incorporated Gas Institute would also urge on the Committee the necessity that the present obligations on gas suppliers should in no respect be injuriously affected.

After passing these resolutions, a joint consultation of your Council's representatives and those of the Incorporated Institution of Gas Engineers was held; the representatives of the latter body being Mr. Charles Hunt (Birmingham), Mr. John Methven (Beckton), and Mr. R. O. Paterson (Cheltenham). The foregoing two resolutions passed by the Council's representatives were read and approved; and it was resolved to submit them to the Committee on behalf of both Institutions, together with the following more detailed recommendations:—

(1) That attention be drawn to Mr. Methven's experiments, showing the influence of the hygrometric condition of the atmosphere on the pentane unit of light; corrections for that source of error appearing to be necessary to enable the pentane candle to be used for standardizing.
(2) That air carburetted with pentane be used for testing purposes.
(3) That a multiple of the standard candle equal to ten candles be produced for testing purposes by the application of a screen to an Argand burner; and that all tests be performed with an open bar photometer not less than 60 inches in length.
(4) That the rate of consumption of the gas to be tested be adjusted as nearly as practicable to the maximum efficiency of the various standard burners.

The joint consultation then terminated. In the afternoon of the same day (June 2), the representatives of the Councils of the two Institutions appeared before the Committee on Photometric Standards at their meeting at No. 8, Richmond Terrace, Whitehall, and submitted the above resolutions and recommendations; expressing also the joint hope that, if possible, some information might be made public as to the work done and proposed to be done by the Committee. I may add that we could get no information from the Committee on the work they had already done *in camerâ*. We were anxious, if we could, to ascertain something of their views, so that we might be able to save their time and our own, and also as a guide to what we might say. However, no information was forthcoming. It is the intention of the Council, with the permission of the members, if time should permit on Thursday, to discuss the question of photometric standards; and we shall be very glad if those who have views of any kind, will be good enough to express them, so that they may be collected together and form a guide to the Council should any consultation take place in the future, and also be put on record, and be seen by those whom we are most anxious should become acquainted with them. I beg now formally to move the adoption of the report.

Mr. J. West (Manchester), in seconding the motion, said all would agree that good work had been done during the past year, especially by the President before the Royal Commission on Labour. No one knew the amount of work imposed upon him; and those who had read his evidence would agree that he had well represented the views of the Institute generally. Most valuable evidence was given; and the members would all be glad to learn that permission to publish it had now been granted, and that it would be embodied in the Transactions of the Institute.

The motion was put and carried unanimously.

The statement of accounts, which had been circulated amongst the members, was then formally presented; and, on the motion of the President, it was at once adopted.

The Birmingham Medal.

The President next presented the Birmingham Medal to Dr. Perkin. In doing so, he said: Dr. Perkin, the gas industry, as well as the textile colouring world, owe to you a debt of gratitude which we, as the body representative of the former, wish to acknowledge, but cannot repay. Hence, I have the pleasure and honour, as President of this Institute, of conveying to you the Birmingham Gold Medal, which is the highest honour we have in our power to confer on any individual, however eminent. On the face of the medallion you will find stamped, among others, the representation of your own features. Your genius has furnished employment for thousands of workmen, as well as a remunerative outlet for millions of capital; and your discoveries have added to the beauty of our homes and the pleasure of our lives. Such a record needs no commendation but its own achievements. As the mouthpiece of this assembly, representing as it does the gas industry of the United Kingdom, I heartily congratulate you, and express to you our earnest desires for many years' further satisfactory enjoyment of your well-earned reputation.

Dr. Perkin, in reply, said: I have to thank you, Sir, very much for the kind remarks you have made, and for presenting me with the medal; and also the Institute for the honour they have done me in awarding the medal. I am very glad that my labours with reference to coal-tar colours have had some little influence on the development of the great industry which you represent.

Premiums for Papers.

The President, in presenting the President's Medal to Professor Vivian B. Lewes, said: It is with great personal pleasure that I hand to you the President's Medal for the year 1891, for your excellent paper, read in your absence by the Secretary, last year at Carlisle, and further as a general acknowledgment of the original work you are doing in very intimate connection with what we are all interested in. You have already succeeded in making clear many points hitherto clouded in doubt; and we are all, during the course of this meeting, in expectation of hearing more from you. On behalf of the Institute, accept my congratulations, and allow me to express our strong desire that we may long have the benefit of your powerful intellect as an assistance in the elucidation of principles, and in furthering their proper practical application.

Professor Lewes, in response, said: Mr. President and Gentlemen,—I thank you very heartily for the great honour you have done me. My work, I can assure you, has been a labour of love; and I only hope that in the future I shall justify the honour you have bestowed upon me this morning.

Mr. A. T. Walmisley, to whom had been awarded the second premium, not being present,

The President presented the third prize to Mr. W. R. Chester, for his paper on "Bye-Products and their Utilization." In doing so, he said: The Council, I am sure, will only be endorsing the unanimous opinion of the members that some recognition should be given of the original way in which you dealt with your subject. Your general work is well before us all; and I find that you are now about to lay us under further obligation to your patience and industry by publishing what will be one of the most useful books of the day—viz., your "Bibliography of Coal Gas." I hope that your book will be well received, and your efforts be thus crowned with success; and that we shall have your presence amongst us to enlighten us further for many years to come.

Mr. Chester briefly returned thanks.

The President, in presenting the next premium to Mr. J. T. Ritson, of Jersey, for his paper on "The Disposal of Sulphate of Ammonia Locally," congratulated him on having treated, in an original and attractive manner, a subject on which many thought it was impossible to say anything new.

Mr. Ritson thanked the Council for the honour awarded him, and also for permitting him to reprint and publish the paper, which he was glad to say had proved very successful.

President's Address.

The President then delivered his Inaugural Address, which was given in the Journal last week (p. 1105).

Mr. J. Hepworth (Carlisle) proposed a vote of thanks to the President for his excellent address. It would, he said, be out of place to discuss it; but he could not refrain from remarking how excellently the President had focussed the leading questions of the day in connection with the gas industry, and how ably he had dealt with them. If Mr. Valon had expressed views which some members would be inclined, on further consideration, to controvert, he would be the last man to quarrel with them on that account; and he was certainly deserving of their warmest thanks.

Mr. G. Anderson (London) seconded the motion. He said he did not think those who had been in the habit of attending the meetings of the Institute for some years past would be of opinion that there was any sign of decadence in the President's address. It was eminently practical, and contained a great deal of information which would repay further study. He had evidently spent a great deal of time in investigating the more intricate parts of the profession, especially the purification of gas, which was not so well understood when the Institute was founded as it now was. Many years ago, he (Mr. Anderson) promulgated certain views which were then considered doubtful, but were now generally accepted, one of which

was the washing of gas, though he never went so far as to recommend using 50 gallons of water to a ton of coal. He thought 10 or 12 gallons might be used advantageously without detriment to the illuminating power of the gas.

The motion was put by Mr. Hepworth, and carried unanimously.

The PRESIDENT said if any efforts of his had been of value to the Institute, he was amply repaid for the trouble he had taken.

The meeting then adjourned for luncheon.

READING OF PAPERS.

On the resumption of the proceedings in the afternoon, the reading of papers was commenced, and was continued on the next and the succeeding day. They were taken in the following order :—

Tuesday.—(1) "Steam Applied as an Aid to the Revivification of Oxide of Iron *in Situ*." By F. G. DEXTER, of Winchester. (2) "Some Analyses and Lighting Values of English Coal Gas, made during the Year 1891." By W. FOSTER, M.A., Professor of Chemistry at the Middlesex Hospital.

Wednesday.—(3) "Difficulties in Tank Construction" [Second Paper]. By THOMAS NEWBIGGING, of Manchester. (4) "The Structural Capacity and Cost of Gas-Works." By W. R. CHESTER, of Nottingham. (5) "Notes on the Carburetting of Gases." By VIVIAN B. LEWES, F.I.C., F.C.S., Professor of Chemistry at the Royal Naval College, Greenwich.

Thursday.—(6) "The External Vertical Standards of Gasholder Framework." By A. T. WALMISLEY, M.Inst.C.E., of London. (7) "Cantilevers and Cantilever Gasholders." By W. GADD, of Manchester.

The first three papers, together with the Murdoch Memorial Lecture, by Professor Lewes, entitled "A Century of Work on the Development of Light from Coal Gas," will be found in another part of the JOURNAL to-day. The remainder, with the report of the discussions, will be given in subsequent issues.

On the re-assembling of the members on Thursday morning, the first business was a discussion on the question of

PHOTOMETRIC STANDARDS.

The PRESIDENT said Mr. Sugg had kindly brought some apparatus to illustrate a standard for testing the illuminating power of gas. It was very ingenious, and could be used away from a gasholder or illuminating power meter —a small steam-engine being used to drive a fan for sending the air through the pentane. After Mr. Sugg had given a description of the appliance, he should be glad for gentlemen present to express their opinions on the matter.

Mr. SUGG said the credit of the application of pentane air gas for the purpose of supplying a standard light belonged to Mr. Vernon Harcourt, one of the Metropolitan Gas Referees. Pentane was the fifth product of the distillation of petroleum, and was a very light volatile spirit—so light, in fact, that if any of it were placed in a cup or glass, the whole of it would immediately evaporate. Its great advantage was its being so volatile that it made very little difference whether the temperature was at freezing-point or at 50° or 60° Fahr. Of course, the temperature of the rooms in which the testing of gas was carried out was never down to freezing-point, or the meters would be frozen up, and the gas would not pass through them. Any temperature below 50°, therefore, need not be considered; and pentane was perfectly volatile at this temperature. The method first proposed by Mr. Vernon Harcourt was to make the gas by putting 3 cubic feet of air into a holder with 9 inches of pentane, which made about 4 cubic feet of the gas. The first thing that occurred to anyone was, Would the gas always be the same? If 9 inches of pentane were dropped into a gasholder, so that none was lost, practically there would be the same quality of gas every time. He tried pentane when it was first brought out ten years ago, and found that any ordinary workman could produce it always of about the same quality; so that a fairly regular quality might be relied upon when made by this method. Since then Mr. Dibdin, the Chemist to the late Metropolitan Board of Works, and now to the London County Council, found that if atmospheric air were passed over the surface of pentane, it would take up a certain quantity; and that practically the same effect could be obtained as if the gas were made in a holder. At first sight, this appeared to be doubtful, because it might be said that, under different conditions of the atmosphere, different quantities would be taken up, and a richer or poorer gas be produced. This, no doubt, was so; but it was corrected in a very simple way, which really amounted to the same thing as if the gas were mixed in a holder. This gas was of very heavy specific gravity; and, when issuing from the burner, it would rather run out of the bottom of the glass than go up. The apparatus before the meeting, therefore consisted of a little steam-engine driving a small fan, which blew the air of the room through the carburetter, in going through which it passed over the surface in the spiral passage, so as to obtain a large surface contact, issued from the centre, and was then conveyed to the burner. Any difference in quality was regulated by turning the tap, so as to get the flame down to the height of 3 inches; and then practically always the same quality of gas was obtained. The height of the flame was due to the quantity of carbon in the gas. If, therefore, the flame were richer, the tap was turned down; if poorer, it was turned up. Thus there was always the same quality of gas with the same height of flame. Even if one did not get quite the same height, the screen cut off the top, and gave the same illuminating power; because if the flame were turned higher, the quantity of air supplied would not be sufficient for perfect combustion, and the illuminating power would be reduced. In the same way, if the flame were not turned up high enough, the illuminating power would be lowered. The value of the standard of light could not be altered except to diminish it—one could not increase it. Cutting off the flame at the top ensured getting the same amount of light from it. He hoped he had made it clear that passing air in this way over a carburetter amounted to the same thing as mixing the gas in a holder; and there was this advantage about it, that the air could be taken from the room without getting any extra moisture in it from the water in a gasholder. Then the question would at once occur, Would there be a possibility of any stratification of the gas in the holder, so that one part might contain gas of one illuminating power, and another part a different quality of gas? If the gas were left for three hours, it would undoubtedly become thoroughly mixed. But supposing even it were not so, and more pentane (the lighter) went to the top, and less to the bottom, this would be found out by the flame being lowered; and if this were done, one had only to turn up the cock so as to get it again to the height of 3 inches. So that practically with this apparatus, when the pentane fluid reached its proper level, from 0·9 to 1 cubic foot of air could be used for passing over the pentane to supply gas for the burner. As the material exhausted itself, there was a greater distance between the surface of the liquid in the top of the carburetter; and consequently the air did not come into so intimate contact with the pentane as at first. It therefore required more air—perhaps 3 cubic feet instead of 1 cubic foot; and yet the illuminating power of the flame would be still the same, because this would be compensated for by turning up the flame to the standard height. He had devised the apparatus to show the working of the process. Of course, with a blower like that before the meeting, the flame was not quite so steady as it would be if worked from a gasholder, or if a small holder were put between to keep the pressure perfectly steady. But the principal cause of the shaking of the flame which might be noticed was not so much the blower as the movement of the air in the room. There were, of course, a number of currents in a place like that in which they were assembled, which would not be found in the air of a photometer-room; and where the flame was perfectly steady, one could read off its height very exactly. He next wished to draw attention to a point which had been mentioned with regard to the facility with which so large a standard could be read on a photometer scale. It had been said that, with such a standard, the distance over which it could be moved to indicate a candle would be so small that one might move it over a candle or two without noticing it; but a little reflection would show that this was not so. He produced a 100-inch photometer scale to illustrate this point; and he pointed out that, if used with an 8-candle standard (so that 2 candles would represent 16-candle gas), the movement between 8 or 7 candles was about 1 inch. When they came to 10 candles, the distance would be

fully 1 inch for the rise of another candle. It became a little smaller between 12 and 13 candles. But the differences between 14, 15, and 16 candles were represented by divisions as wide as nearly $\frac{3}{4}$ inch, and more than $\frac{1}{2}$ inch; and one could not move the disc 0·1 inch without seeing it. So that 0·1 candle would easily be read off from such a bar. This disposed of the argument that a 10 or a 16 candle standard would be more difficult to read than the 2-candle standard. Mr. Harcourt's first proposition was that the candle should be represented by a flame very much like that of the ordinary standard candle; and when he first brought it out, he must by some means have been deceived in the calculation of the jet, because he had in use a 10-candle standard which was, as nearly as possible, the same as the one now shown, with the exception that the holes were larger. This was used with ordinary gas; and so long as it did not alter more than about a candle, the variations of the standard were so slight that they might be disregarded. He had used this for the last 15 years for the purpose of keeping standard candles in something like proper order, so that the materials should not be changed, and the illuminating power of the candles used by different gas companies should be as nearly as possible constant. It would be perfectly impossible to make candles absolutely identical; but if one had them as nearly as practicable the same, having similar materials and wicks, the amount of light per grain of spermaceti consumed was to all intents and purposes the same. He made use of this; and the application of the pentane to this burner, with the variation suited to the pentane air gas, had made the standard perfectly steady; and it did not require any correction at all for temperature or barometric pressure—it corrected itself. Professor Lewes, in his lecture, had set him (Mr. Sugg) thinking about the way in which that standard adjusted itself; and he confessed that he had had some difficulty in understanding it. When the temperature, for example, was high and the barometer low, there would, no doubt, be a difference in the quantity of gas issuing from the burner, because there would not be so much pressure on the top. But at the same time the oxygen of the atmosphere would be attenuated; and there would be less of it close to the burner—the blue would go up a little higher to correct it. This was how he supposed the burner had hitherto corrected itself. If they cast off the blue from the bottom, it did not correct itself, and did not give the same result—it was variable; but if they left the blue in, and cut off the top, they had a standard which was invariable. Multiples of this could now be made up from the 10 candles—in fact, they could make a 5, 10, 16, or up to a 30 candle standard. He did not understand that there would be any difficulty in making a 20 or a 30-candle Argand burner; it would have to be made in the same way. It might be noticed that there was a certain "bellying-out" of the flame. They had tried to make it straight; but, if this was done, it did not correct itself in the same way as the slightly bellied flame did. He would not attempt to give the reason for this, because really he did not know it. He had thought that it was owing to the way in which the oxygen reached the flame; but Professor Lewes had materially altered his (Mr. Sugg's) views with regard to some things which occurred in these standard burners. In looking over the recommendations sent to the Committee on Photometric Standards, he noticed that the first was that the standard should be based on, and be of the same value as, the existing parliamentary standard. There had been some considerable discussion about this matter; and it had been suggested that the candles had deteriorated, so that they gave less light per grain of spermaceti than they ought to do. But he could state distinctly that this was not the case. He could prove that the candles had not altered by the standard with which he had always been accustomed to work. The number of strands in the wick had not been changed, neither had the admixture of wax with the spermaceti; and he believed they remained exactly the same as they were in 1881. The difficulty to be surmounted, which he thought had now been accomplished, was to know what a parliamentary candle was. Taking the unit of light as Mr. Harcourt's one candle, it was evident, from the beginning, that this was more than a candle; but how much more, was not perhaps exactly known. It was certainly within 0·05 or 0·06 more than a candle. He believed a decision had been arrived at by splitting the difference, and it was now reckoned as 0·25 of a candle; and the unit had been reduced, so that the light now shown had been standardized accordingly. It was not very far out; but it might be slightly different to what it would be when standardized. Another recommendation was that all tests should be made upon an open bar photometer of not less than 60 inches in length. He thought it would be better, if an open bar photometer were used, that the room in which it was placed should also be defined; because it was quite clear that there was a chance of the reflection of the gas getting on to the ceiling or on to the wall, and coming back again, which must help the candle. This he knew was so in some instances; because they had recently met with a case where two instruments, standardized by the Standards Departments of the Board of Trade, did not give exactly the same result—one being fixed in one room, and the other in another room. Both instruments were precisely alike, and when put together in one room, they gave exactly the same result. He had prepared the apparatus roughly, in order that he might test it by the standard of light, so that they might find a difference between the two photometers, and ascertain the cause. He only mentioned this incidentally, because some experiments which had been made had led to the retardation of the adoption of this system. He believed they had been made with an open photometer, and did not always give exactly the same results. If it were properly screened, so that the shadows did not fall on the disc at any point, they would produce the same effects as a closed photometer.

The PRESIDENT said the members were much obliged to Mr. Sugg for the very clear and lucid manner in which he had introduced the subject.

Mr. N. H. HUMPHRYS (Salisbury) said, as one of the representatives who waited on the Committee on Photometric Standards, he thought it only right to explain to the members of the Institute the position in which they stood. They were invited to appear before the Committee at somewhat short notice; and they were quite unable to have the advantage of consulting with some other members. Perhaps, in several ways, it would have been better if they could have met the Committee after the discussion now being held; but when he was requested to form one of the Committee, he considered it very desirable that the Institute should go before the Standards Committee, and show them that, while they did not seek any advantage to themselves from the introduction of a standard which would enable them to diminish the quality of gas in any way, on the other hand, representing (as they did) a very large interest—the quantity of gas sold under existing parliamentary obligations amounting to several millions sterling—it was important that the standard should not be raised even by a decimal point, but that the existing standard or unit should be maintained. No doubt, if there had been more time, they could have discussed several other details. But he did not attach very much importance to them; and no doubt the Committee would thoroughly thrash them out. The important point was to keep exactly as they were. They were fighting a hard battle, with rising prices for coal and labour; and they did not want to be burdened in the slightest degree more than they were now.

Mr. JOHN WEST (Manchester), also as one of the representatives selected to appear before the Standards Committee, said it might be as well for him to give his views. Being called together very hurriedly, as Mr. Humphrys had stated, there was not much time for consideration; and they had to fall back upon past experience. No doubt the Committee had been appointed in consequence of the unsatisfactory way in which the testing of gas was carried out in London and surrounding districts. The Gas Companies and the official testers of the County Council found very great divergence and disagreement in their results. This arose from various causes; but it appeared to be mostly attributed to the defectiveness of the candles. For his own part, he thought the candles, although they were not the right thing, had had more complaints made against them than were thoroughly justified; and he had a belief that, if everyone were in earnest, and made very careful experiments, much better results could be obtained from them than was sometimes found to be the case. Then the photometers had been altered again and again, until gas companies scarcely knew where they were. It appeared to him that all the changes made in photometers had been in the direction opposed to the interests of gas companies; and therefore managers were anxious that

some more definite standard of light should be authorized. He should like to have seen the Methven standard adopted, because it was very largely used in the Manchester district, and was a very good one, though not perhaps so perfect as it might be; but it was known how it could be improved and made a perfect standard. He believed, however, that this method would not be entertained, because the Committee were averse to testing gas against gas; and the probability was that the standard eventually adopted would be the pentane one of Mr. Vernon Harcourt. Some little time was spent in framing the resolutions. The gas companies and corporations did not wish to gain any advantage by a change of standard; but they knew that whatever was settled as best for the London Gas Companies would affect the whole country when they went to Parliament for renewed powers. Many years ago, he made a hobby of testing gas and burners; and, in connection with the late Mr. F. W. Hartley, he had made a great many tests. He remembered at once, when this question cropped up, that what was called the Vernon Harcourt pentane standard candle many years ago gave more light when consuming ½ cubic foot per hour than the ordinary standard sperm candle; and they were desirous that this should not be adopted, because, if that were so, gas companies and corporations would be handicapped to that extent. For this reason they had put forward the recommendation that any standard adopted should have the same relative value as the existing parliamentary unit. Experiment showed that the Vernon Harcourt standard gave about 4 per cent. more light than the standard sperm candle. Mr. Sugg said 5 per cent.; but he (Mr. West) put it very moderately at 4 per cent. They had, since they saw the Standards of Light Committee, heard that the gas companies, in order to have the matter settled in some way, rather than go on with the old candle, had agreed to compromise the matter, and accept it as giving 2½ per cent. additional light over the old sperm candle. In doing this, he did not hesitate to say they were giving something away —perhaps 1 or 1½ per cent. He rather objected to this standard, because there was the making of the pentane, which was somewhat difficult, though Mr. Sugg had said it was not so now. In days gone by, they used to find it troublesome; and all he could say, on behalf of managers of moderate-sized works, was that he did not want to see them encumbered with any more difficulties than they had to contend with at present. Presuming that this would be the standard, the next question was what multiple it should be—2, 5, or 10 candles. He himself was in favour of the 10-candle standard, such as Mr. Sugg had described; and he thought this would work very well with all kinds of gas, either 16, 20, or even 30 candle. He believed the President did not quite agree with him on this point, and would rather have a burner made specially for every quality of gas supplied. After the resolutions had been passed, the representatives of the Institute met the representatives of the Institution of Gas Engineers—Messrs. Hunt, Methven, and Paterson—and framed another set of recommendations. The first and second were agreed to unanimously; but upon the third they were not quite unanimous. He certainly agreed with it, and wished they had done as Mr. Sugg had suggested, and recommended the size of the experimental room; but it would take up too much time to go fully into the matter. The fourth resolution might require a little explanation. Some of the members might have seen, in the JOURNAL OF GAS LIGHTING,* an account of Mr. Hunt's experiments. His idea was that the gas should be tested with a chimney full of flame, regardless of quantity. He showed that, when he had only a moderate light in the burner, the gas would give a light equal to 10 candles; but when he filled the chimney, after making corrections in every way, he had more than 14 candles. So that there was an advantage in burning the gas as he considered properly, irrespective of the quantity of gas consumed. He believed the President dissented from this view. With regard to the burner, his own idea was that they should not have burners for every kind of gas, but there might perhaps be three sizes—one, the "London" Argand burner, for gas of 14 to 16 candle power; another for richer gas, such as they supplied in Manchester and Birmingham, of 17 to 21 candle power; and another for gas of from 25 to 30 candle power, which might do for Scotland. He thought three burners of this kind, arranged by someone who understood the matter, and certified by the Board of Trade, would be quite sufficient; and they should all be Argands. Some who supplied rich gas were under the difficulty that they could not test it properly with the "London" Argand. In Manchester they tested with the flat-flame burner on this account. The 10-candle burner was not a new notion—in fact, it had been in use for some 15 years for standardizing the candles. [Mr. SUGG: Only in my private laboratory for that time.] He had no doubt that the Standards Committee were anxious to do what was right and proper to all parties.

The PRESIDENT said it was perfectly true that he was not quite in accord with one or two of the resolutions which had been put forward; but he wished now, if possible, to say nothing about the Standards Committee, but simply to mention that the first and second resolutions, which were passed by themselves and accepted by the Institution of Gas Engineers, represented exactly his views. With regard to the subsequent resolutions propounded, his objection was to having any fixed standard; believing, as he did, that the standard should be a multiple of the unit, whatever it was. For instance, if they went to Parliament with a Bill undertaking to supply 14-candle gas, he thought that there should be a 14-candle gas at one end of the bar, and a 14 candle standard at the other end. The same with 16, 18, and other candle gas. There should always be a standard burner representing the obligations under which they were. His objection was not so great to the exact quantity of light being at the one end of the bar as at the other; and he should be prepared to accept the 10-candle standard, because the variation would not be very great; it was a very fair division of the bar, a very convenient light to have, and the calculations could easily be made. On the other hand, he could not accept the proposition that the rate of 5 cubic feet per hour should be done away with, and that they should simply test with a chimney full of flame, so as to get the best result out of the gas, and then calculate back for the consumption. Everyone who had used a photometer knew the result of this. Gas which would give an illuminating power of about 10 candles when burning the rigid 5 cubic feet per hour, would, under the conditions named, show something more than 14 candles. This improvement gradually diminished as the gas increased in power. If they reached 16, 16½, or 17 candles, they obtained a balance; and the 17-candle gas would show 17 candles, and no more. Immediately they tried to burn a richer gas than this in the same chimney, an opposite effect was produced; and instead of getting a better result, they had a worse one. It seemed to him, therefore, that any method by which they burnt gas under the condition that a poor gas would show a better result and a rich gas a poorer one, could not be adopted as a standard. The resolutions which had been printed and circulated showed what the majority of the joint deputations of the two Gas Institutions agreed to; but he thought it necessary to make this statement, so that he might, in his individual capacity, be free in the future to discuss the points he had mentioned.

THE SECOND PREMIUM.

The PRESIDENT presented the second premium to Mr. A. T. Walmisley, who was unable to be in attendance on Tuesday to receive it. In doing so, he said: Your painstaking paper, read last year, on "The Effects of Wind Pressure on Retort-House Roofs and Gasholders," has been adjudged to rank next in place to the one receiving the President's Medal. It contained information on what to us is an important matter—much of it new. It will stand in our Transactions as a paper of reference for all those requiring guidance on a subject not too well understood; and you will have the satisfaction of knowing that your labours are appreciated by the profession. It is therefore with great pleasure I hand you this cheque.

Mr. WALMISLEY expressed his appreciation of the honour which had been conferred upon him in awarding him the premium, which, he said, was quite unexpected. He had gone into the matter as being one that was interesting to himself, and desiring to arrive at the truth; and if his labours were appreciated by a body of gentlemen who were intimately acquainted with the practice of wind pressure upon gasholders, it showed that they had not been thrown away.

* See Vol. LVII., p. 1096.

REPORT OF THE SCRUTINEERS.

The result of the election of office-bearers for the ensuing year was as follows:—

President.—Denny Lane, of Cork.

Vice-Presidents.—John West, of Manchester; R. Mitchell, of Edinburgh.

New Members of Council.—G. F. L. Foulger, of London; T. H. Martin, of New Barnet; S. R. Ogden, of Blackburn; and H. Wimhurst, of Sleaford.

Auditors.—T. W. R. White, of Sherborne; S. W. Durkin, of Southampton.

Honorary Secretary.—J. Hepworth, of Carlisle.

The Council explained, on the balloting-paper, that, in accordance with Rule 41, they had appointed Mr. Norton H. Humphrys, of Salisbury, as an ordinary member of the Council, to fill the vacancy caused by the resignation of Mr. A. Mead.

NEW MEMBERS.

The SECRETARY read the following list of new members and associates, and of those transferred to the class of Members:—

Members.—Adlington, E. L., Worcester; Andrews, J., Langley Mill and Heanor; Beynon, R. W. C., Torquay; Francis, A., Tavistock; Hawkins, J. E., Invercargill (N.Z.); Lawton, H., Carnforth; Ogden, S. R., jun., Maryport; Rust, J. L., Chepstow; Taylor, W., Glossop; Wilkinson, H., Harrogate; Weller, F., Southtown, Great Yarmouth.

Associate Members.—Dann, T., Bedford; Pooley, H., Birkenhead; Robinson, C. J., Ilkeston.

Associates.—Creeke, R. W. B., Leven (Fife); Ellice-Clark, E. B., London; Lewes, V. B., Greenwich; Sheldrake, J. H., London.

Transferences.—Associate Members to Members: Jowett, T., East Grinstead; Sutcliffe, V. J., Bradford. Associates to Members: Lass, Alfred, F.C.A., London; Tallentire, W., Lurgan.

The SECRETARY said that several applications for membership had been received too late. He therefore wished to remind gentlemen that all such applications should be forwarded before the 31st of March in each year. Those he had received too late would be held over until next year. He then, in accordance with the rules, read the list of the members who were two years in arrear with their subscriptions.

AN HONORARY MEMBER.

The PRESIDENT said he had the pleasure of nominating the President of the French Technical Institute (M. Mallé) as an honorary member. The Société Technique du Gaz en France had always made the Presidents of The Gas Institute honorary members of their Society; and the Institute had reciprocated by making their Presidents honorary members. He felt it a great honour when it was conferred upon him; and he had much pleasure, therefore, in submitting the resolution.

The proposition was carried unanimously.

PLACE OF NEXT MEETING.

The PRESIDENT said Mr. Denny Lane had been elected for the second time President of the Institute. He was a man whom they all held in very high esteem, as was shown by the unanimous vote in his favour; and he felt sure that, under his presidency, they would have a very successful year. Then came the question of deciding on the place of meeting. Mr. Denny Lane had written a letter expressing his regret at not being able to be present, owing to ill-health, which rendered it unadvisable for him to take so long a journey. He (the President) saw him a few weeks ago, when he fully expected to be able to attend on this occasion. He proposed that they should fix upon either London or Belfast for the next meeting. It was to be urged in favour of Belfast that it was on Irish ground, and they had an Irish President; but it was not his own town. If, however, they went to Cork, he understood some trouble would be experienced in finding accommodation. He believed there might also be difficulty of the same character at Belfast. With regard to London, there had been a strong recommendation to the Council to hold the next meeting in the Metropolis; a large number of members thinking that, as all roads led to London, this was a good place to meet in as often as possible. It was, of course, for the members to decide.

Mr. D. M. NELSON (Glasgow) said he believed, though there was no very great amount of accommodation in Belfast, there were several very pleasant little places just outside the town, which were easily accessible, where it could be found.

Mr. T. TRAVERS (Cork) did not think there was that want of accommodation which seemed to be anticipated. It was certainly the first time he had ever heard such a suggestion. He thought gentlemen would find that Belfast would afford as good accommodation, considering it was a town of 100,000 inhabitants, as a great many of the places they had visited. He might fairly say that the natural beauties of the place would amply compensate for any shortcomings there might be.

Mr. P. SIMPSON (Rugby) said he would move that the next meeting-place be Belfast. They could not do better than keep to the old custom of one year in London and one year out. He had not the least fear of the accommodation being deficient.

Mr. H. WIMHURST (Sleaford) seconded the motion.

Mr. SIMPSON remarked that they had a great many members from Ireland, and they had only been there once before; and on that occasion they were very courteously treated.

There being no amendment, the PRESIDENT put the resolution, and it was carried unanimously.

VOTES OF THANKS.

The PRESIDENT said his next duty was to propose a vote of thanks to the President and Council of the Institution of Civil Engineers for their kindness in according the use of that very splendid room for the meeting. It was not by any means the first time they had received this hospitality; but they did not appreciate it any the less on this account. The courtesy and kindness they met with from everyone connected with the place was very pleasant to each individual member of the Institute.

The resolution was carried by acclamation.

The PRESIDENT next proposed a vote of thanks to Mr. Foulger for his kindness in giving the members day by day an opportunity of visiting the Goswell Road station and inspecting the method of distributing the gas from the stations of The Gaslight and Coke Company. Mr. Foulger had now been elected a member of the Council; and he (the President) was quite sure he would be a valuable member, considering the way in which he had taken the work in hand, even before he was appointed.

The resolution having been carried unanimously,

Mr. FOULGER thanked the members for the manner in which the resolution had been received.

Mr. HEPWORTH then proposed a hearty vote of thanks to those gentlemen who had read papers. He said it was always somewhat invidious to make comparisons, not only of paper with paper, but of session with session; but it might be fairly said that the papers contributed this year had not been surpassed on any previous occasion, and there were two at least which would stand out prominently to be perused for many years to come.

Mr. T. H. MARTIN (New Barnet) seconded the motion; and it was carried unanimously.

Mr. SIMPSON then moved a vote of thanks to the Scrutineers.

Mr. W. R. COOPER (Banbury) seconded the motion; and it was carried unanimously.

Mr. A. DOUGALL (Tunbridge Wells) said they were now drawing to the close of a very enjoyable and instructive session, and their thanks were eminently due to those who had arranged the business as well as the pleasures of the meeting. He therefore proposed a hearty vote of thanks to the Council of the Institute, for the time and attention they had given to the business.

Mr. W. A. PADFIELD (Exeter) seconded the proposition, which was cordially adopted.

On the motion of Mr. W. SMITH (Hyde), seconded by Mr. D. VASS (Portobello), a vote of thanks was passed to the Auditors—Messrs. White and Martin.

Mr. HEPWORTH next moved that the hearty thanks of the Institute be presented to the President, for his able services during the past twelve months. It had, he said, been his privilege to see the President's work during the whole of the year, having been very closely associated with him; and whatever former Presidents might have done, no one could have exceeded, if they had equalled, the work Mr. Valon had performed for the benefit of the

Institute. It was a matter of regret to him that there was not some way of asking the President to take office for a second year. He saw behind him the names of honoured engineers who had filled that office in connection with the Institution of Civil Engineers for two years in succession; and he thought they might do worse than copy that plan when they had such a man as Mr. Valon to occupy the chair. It was mentioned a few days previously that the work of collecting evidence for the Labour Commission had fallen specially on him; and he (Mr. Hepworth) did not think any words could exaggerate the magnitude and importance of the work Mr. Valon did, and did so ably and willingly, while that matter was under discussion. It unfortunately happened that they were not all prompt and businesslike; and he knew, as a matter of fact, that a great many gentlemen who replied to the communications from the office in connection with the Labour Commission might have done so a great deal sooner than they did. But probably they thought that it was a big question, and required considerable time to deal with. At all events, whether the labour had been much or little, no one could question the willingness as well as the ability of the President to undertake it. Before sitting down, it was only right to say they were indebted to Mr. Valon, as they had been to no other President before, for his kindly hospitality at the Westminster Town Hall. It was not every President who could do what Mr. and Mrs. Valon did so gracefully on the previous evening. But without discussing this phase of the question, everyone must have thoroughly appreciated what they did, and must feel grateful to them for initiating such a pleasant feature in their meetings.

Mr. R. Mitchell (Edinburgh) said that he had great pleasure in seconding the motion so ably proposed by Mr. Hepworth. He would not detract from the force of that gentleman's observations by attempting to add anything to them. The only way they had of showing their appreciation of the great kindness of Mr. Valon was to pass him the heartiest vote of thanks possible for his services during his term of office.

Mr. G. Anderson (London) said he had been a member of the Institute for some 24 or 25 years; and he must say he thought this the most successful meeting they had ever had. He had, he thought, never seen larger attendances; but there was one special feature about this meeting, that they seemed to have got rid of everything approaching the slightest semblance of disorder. In proof of this, they had carried unanimously the resolution fixing the place for the next meeting; and he never remembered that this had been done before. No doubt a great deal of the success was due to the President; and the only reason he (Mr. Anderson) objected to Mr. Hepworth's suggestion about electing him for a second term was that which Mr. Hepworth had himself adduced—viz., the great amount of labour which had been thrown upon him during the past year. He would only suggest that they should give him a rest, and then bring him forward again.

The resolution having been carried by acclamation,

The President, in responding, thanked Mr. Hepworth very much for the kind words he had used, and the whole of the members for the consideration they had shown him since he had been President. Wherever he had gone, in all parts of the country, he had had the same reception from every member, and also at the meetings of the District Associations. If his efforts had been successful in cementing and holding the Institute together, the object he had in view would have been accomplished. While they could have meetings like the present one, and like those they had had before, where earnest business men with business intentions were intent to teach and intent to learn, they could not do better than continue on their present lines. He certainly thought that in an Institute like this, which met annually, they should, as far as possible, have a judicious mixture of pleasure and amusement as well as serious business which occupied them in the daytime. They ought to have an opportunity of speaking to each other untrammelled by any kind of form; and he was quite sure the means they adopted of social intercourse added a great deal to the value of the Institute. Most of them were isolated. It was very true that he and a few others had an opportunity of meeting their fellows more frequently than some; but the bulk of the Institute went away, and perhaps did not see each other until they met again in another twelve months. He hoped, therefore, they would always continue on the same lines of common sense on which they were now; that the Institute would do as it was doing—grow from day to day. Speaking with the responsibility of his position, and knowing the inside work of the Institute, he could say most truthfully that there was not the slightest sign of decay of vitality in any possible way, but quite the contrary. He urged them all, therefore, to bring suitable members to the Institute. They wanted them, because they wanted numbers in order to enable the thing to be worked as it should be, and to make it, as it had been, an Institute representative of themselves and of the great gas industry. If any efforts of his during the last year had tended to this end, and if any services he could render in the future would further this object, he was amply rewarded. He thanked the members very sincerely for the great kindness they had shown him on all occasions during his tenure of office. Continuing, he proposed a vote of thanks to the Secretary, for the way in which he had discharged his duties during the past year. No one, he said, knew so well as the President how irritating and how tiresome some of the Secretary's duties were. During the last three or four weeks, it had been nearly night and day work; and therefore he was fully entitled to a hearty vote of thanks.

Mr. S. W. Durkin (Southampton) said he had been on the Council under three Presidents, and had had some experience of the Secretary's arduous duties; and he fully concurred in what the President had said with regard to the assiduity with which Mr. Harvey discharged them.

The motion having been carried,

Mr. Harvey, in responding, said that he was very glad indeed if any efforts he had made to do the work of the Institute thoroughly and well had met with the appreciation of the members; and he could assure them that, as long as he occupied his present position, he should hope to give equal satisfaction.

The proceedings then closed.

PAPERS READ AT THE MEETING.

STEAM APPLIED AS AN AID TO THE REVIVIFICATION OF OXIDE OF IRON "IN SITU."

By Frederick G. Dexter, of Winchester.

The purification of gas in closed vessels is not by any means a new subject. It has received close attention (more particularly of late years) at the hands of many able men, and under varying circumstances. The "Claus" process and the "Oxygen" process representing modern attempts, probably owe their birth to the attention drawn to possible results by the introduction to the purifiers of a small percentage of air with the crude gas.

It is not the writer's intention to take up the time of the meeting by recapitulating the many theories, opinions, and facts which have been given from time to time in support of, or in opposition to, the air process, as ordinarily tried or saddled with the cost of carburetting. They are, more or less, all well known to you. One paper in particular by Mr. Valon, our President, given in the Institute "Transactions for 1889," summed up the debateable question very shortly. He, having tried the effect of air purification, and found it (at any rate under his circumstances) objectionable, had immediately set about trials with oxygen pure and simple, with the truly beautiful results already recorded. That paper, in effect, seemed to tell us that both opponents and exponents of air revivification were wrong—the only true solution being oxygen undiluted. In the subsequent discussion, Mr. N. H. Humphrys found himself unable to reconcile the statement that $\frac{1}{2}$ per cent. of free oxygen mixed with $99\frac{1}{2}$ per cent. of crude gas—or rather a mixture of crude gases—could differ in active properties from $\frac{1}{2}$ per cent. of oxygen mixed with a similar quantity of crude gases, because the said $99\frac{1}{2}$ per cent. of mixture in the second case had 2 per cent. of nitrogen with it, passed in with the oxygen as air. There can be no doubt that the incredulity then expressed, found an echo in many other minds. But it appeared to me, after the reading of that paper, and in spite of the very interesting results brought to light in the "History of a Heap of Oxide" given by Mr. Humphrys,* that the days of air revivification were numbered, if the facts there recorded were substantiated in other quarters,

* See Journal, Vol. LIV., p. 50.

and no better results were possible. During the same discussion, Dr. Thorne, in endeavouring to throw some light upon the discrepancy between results obtained with air and oxygen (the percentages of oxygen being identical), said: "But the chemical world was startled some few years ago, by experiments made by Professor Harold B. Dixon and others, in which it was shown that if the oxygen were perfectly dry—in a state of dryness, such as, until that time, had been quite unknown—then the power of the oxygen to support combustion was enormously *decreased*. One might heat sulphur in *dry* oxygen to such a point that it sublimed, without its burning; and one might heat a piece of charcoal in oxygen to a bright-red heat, take the flame away, and it would go back again without any visible burning. But the moment the merest trace of moisture was introduced, the effect was quite different; the carbon, or sulphur, or phosphorus, or whatever it might be, immediately burst into flame." These remarks, and others of a similar nature, had considerable weight in my own mind; and although I had often thought upon the "Air *versus* Oxygen" question before, without arriving at any satisfactory solution, the conviction then flashed upon me that in this quality of dryness lay the secret—not, however, in the form of accounting for oxygen being so far superior to air, but as explaining why air had not been made to more closely approach oxygen under conditions suitable to its use.

Moisture plays a most important part in Nature; its combinations are inconceivably numerous, and but few chemical reactions are possible without its aid. The instances given by Dr. Thorne might be multiplied many times over. To give one which immediately occurred to my mind—the simple process of rust formation on iron. Here there is a chemical combination—practically combustion, evolving a certain degree of heat. It is the union of oxygen and iron with that all-important aid, moisture. Does rust, or oxide of iron, form in a current of perfectly dry air, however much prolonged? The ferric hydrates, or natural bog ores, contain in their natural state as much as 50 per cent. of water. Even if treated with dry sawdust before use, they will frequently contain (as used in the purifiers) 25 to 30 per cent. of moisture. Artificial oxides also are of necessity "watered" before use; and it is hardly needful for me to remind members of the practice of "watering" oxide when spread upon the revivifying floor, and even of the practice, as I once heard, of raising a purifier lid to water the contents, as an aid to greater efficiency.

Having, I trust, drawn your attention to the fact that damp oxide is of recognized importance, and that when oxide has been allowed to get thoroughly dry its efficiency in the box is seriously curtailed, I wish to point out that the air process as ordinarily applied is directly responsible for, and rapidly brings about, this very evil—the drying of the oxide; while, as far as I am aware, not only have no efforts been made to counteract this evil, but apparently the matter has altogether escaped the attention it deserves. A few months since, I had the honour of presenting to the South-West Association of Gas Managers a paper dealing with the "Revivifying of Oxide of Iron in Closed Boxes,"* by means of a blast of air, derived from a pressure-blower; the box being disconnected from the working series during the operation. The same idea, carried out, however, in a different way, had previously been attempted, but abandoned owing to the extreme difficulty experienced with the hardening or caking together of the oxide. This obstacle, I felt convinced, could be overcome by the use of suitable opening material, and proper attention to the humidity of the oxide. The subject is here introduced only to show the effect produced in a case analogous to the subject of the present paper. I found that the heat produced during the chemical reactions or revivification of the oxide was quite sufficient to drive off, in the form of vapour, the water liberated by the reactions, as well as any mechanically mixed with the material. It was, in effect, simply baking out the moisture; and if the meeting will recall for a moment the caking together and hardening effect in the case of the drying-up of common mould, mud, clay, or any similar material, it will not be found difficult to account for.

To satisfy myself thoroughly upon this point, I had arrangements made to condense the moisture blown off with the air and gases at the plug of the purifier; and I carefully compared samples of the same material immediately before applying the air-blast and after. The result showed me that considerable quantities of water were driven off by the agency of the heat of the reaction; and the difference between the condition of the oxide before and after treatment with air was most marked. In fact, if the air was not well controlled, it was quite possible to so harden or dry off the layer first affected as to render it impervious to the air current for all practical purposes. Here, then, appeared to me an explanation of a common difficulty, and sometimes entire want of success experienced by users of the ordinary air process.

The chemical reactions effected within an oxide purifier treated with a small percentage of air are of precisely the same character as occur with the same oxide removed to the revivifying floor, or to a spent box treated by a blast in the way just referred to. But while the reactions are similar, the conditions are very different. Oxide revivified upon an open floor has this advantage—the heat disengaged can get away quite freely, without necessarily raising its temperature to any great extent. It is, if dry, in a position to absorb moisture from the atmosphere; and, further, should the material not be in a sufficiently damp state, its condition would undoubtedly be noticed, and the necessary moisture added by watering before it was replaced in the box. In applying the air process, however, what occurs? The heat formerly allowed to escape is pent up; it is allowed to become intensified to such an extent, at times, as to cause the oxide and sulphur to fire, and the grids to burn. This catastrophe, while admittedly due to mismanagement, as it shows want of attention to the correct proportioning of the air supply, still serves the purpose of illustrating the intensity of the reactions produced. It is simply a question of degree, the amount of heat liberated in a given time depending entirely on the rapidity of the air supply in conjunction with the condition of the oxide. The quantity of heat is at all times more than sufficient—especially well within the layers—to cause the rapid evaporation of moisture, the presence of which is one of the most important conditions of success.

It is to be noted that the abstraction of moisture acts detrimentally in two ways—mechanically and chemically. (1) Mechanically, by the drying up, hardening, or caking together of the oxide, which causes greater resistance to the passage of the gas. (2) Chemically, by impairing the active properties of the oxide. Of the former effect, many have in the past given their experience; and several instances could be given of boxes shut off, long before properly spent, through sheer inability to get the gas through the material, which has even required the use of pickaxes to disengage. Of the latter, or chemical aspect, I do not think the last word has yet been said. In fact, I am coming to the conclusion that, if the mechanical difficulty did not first assert itself, and put an end on this score alone to further work, the oxide could be so deprived of moisture as to put an almost entire stop to revivification. I hope, before concluding these remarks, to give such evidence on this point as will clearly indicate the necessity of attention in this direction.

In jotting down information in connection with Mr. Valon's and Dr. Thorne's remarks on the oxygen process, as given in the paper before referred to, and in connection with the various experiences recorded with the air process, as well as my own experiments, I had the following notes:

(1) A given percentage of free oxygen admitted to purifiers appeared to have far higher revivifying effect than exactly the same percentage of oxygen admitted in conjunction with 2 per cent. of nitrogen as air.

(2) The presence of moisture is of primary importance in most chemical reactions. It is known to have an extraordinary influence upon the combination or activity of the particular element under consideration—*i.e.*, oxygen.

(3) The absence of moisture in oxide used for purification has an injurious effect; special steps being always taken under ordinary circumstances to ensure its presence.

(4) The production of hydrated ferric oxide in the active form absolutely depends upon water for its constitution, whether the reaction from sulphide takes place on the revivifying floor or inside a purifier.

* See JOURNAL, Vol. LVII., p. 643.

(5) That, while the conditions of revivification on an open floor favour the assimilation of moisture either naturally or artificially, the conditions of the closed box not only directly preclude this, but, by means of the heat produced, aid the abstraction of moisture, driving forward along with the gas whatever might be liberated chemically or exist mechanically mixed.

(6) That the difficulty of back-pressure caused by caking, was again directly traceable to the removal of moisture.

(7) That, in revivifying purifiers by an air-blast taken in at the bottom, and the current removed at the top, revivification always proceeded in the reverse direction to the blast—*i.e.*, from the top downwards. But, while the top material with less air became damp from moisture driven forward from lower layers, the bottom, which took longer to revivify, though in contact with more air, remained very dry.

The enumeration and study of these points led to but one conclusion. The air process tended to become self-destructive by the removal of the necessary moisture; and although at some works a greater measure of success would be experienced than at others—due to the varying amount of moisture present in the oxide originally, or in the gas, or the proportion of air used—yet there appeared very good ground to believe that no results were so good but that they could be greatly improved. The present uncertainty as to the possible life of any box could be reduced to definite lines, if the important question of humidity received the necessary attention.

While collecting these notes, and trying the effect of the ordinary air process with the admission of varying quantities up to a little over 2 per cent., a circumstance occurred which seemed to me to put all doubt at rest. The ordinary process had been working for some time, with results apparently as satisfactory as were obtained elsewhere. Speaking generally, the boxes, while gradually increasing in back-pressure, did not give exceptional trouble, necessitating shutting off, except in a few instances, or towards what appeared to be the limit of their life by ordinary tests. Having occasion to change over to a separate section of retort-house, attention was called within two days to the impossibility of getting the gas through the purifiers. A new box having been added only four days before, I could not for awhile account for this extraordinary behaviour; the back-pressure on the first of the series having risen in this short time from 4 to 18 inches. On shutting this box off, and making the second box the first, a similar increased resistance arose within the next 30 hours, and again a repetition with the third box. This was a very serious matter; and upon investigating into the cause, I found that each box became decidedly warm in comparison with the temperature usually found. I at once came to the conclusion that the mischief arose through an increased quantity of air being drawn in owing to some fault in the new retort section which was put to work. This surmise proved correct; and the oxide, having been removed, broken up, and freshly damped, was again used in turn with no further difficulty. This experience convinced me that, if means were devised to prevent moisture leaving the oxide under revivification, or, if it did do so, to replace it continuously, the greatest possible benefit would result.

I saw that, according to "King's Treatise on Coal Gas" (Vol. I., p. 377), Mr. Cleland, in applying a jet of steam for scrubbing purposes, claimed a saving of one-third in labour and material (oxide) in the purifiers, by reason of the complete removal of ammonia and arrestation of tar oil and *water* before the gas reached the oxide or lime purifier. This indicates that one of the conditions of success was that the moisture or steam should be prevented from entering the purifiers; and probably at that time, without the altered conditions of air revivification, the object was so far right. Under the conditions here discussed, however, the reverse is true. Moisture is urgently needed. Mr. George Anderson on the subject of "Gas Purifiers,"* in his paper read in 1889, said: "He formed the opinion that to purify gas there must be humidity; and the more humidity there was without doing damage, the better." *Exhaust* steam having necessarily the greater part of its heat removed, appeared to me one of the best possible means of introducing moisture—being itself nothing but warm water vapour, in the finest possible state of division, and therefore readily adaptable to bring about complete admixture with the gas, and consequently in the most favourable state and condition to come into contact with the oxide.

On thinking over the details for the proposed trial, it occurred to me that the gas itself would probably exercise an affinity for, and take up a certain proportion of, moisture, if allowed to come into contact a sufficient time—added to which it would be necessary to adopt some means of control in case the amount of exhaust steam admitted should prove too great, or the reverse, as my idea was to turn to account the exhaust from the exhauster engine. Having at my disposal an annular condenser, I applied the exhaust steam by means of two jets—one above and one below the gas inlet; and the path of the steam being at right angles to that of the gas, thorough admixture was obtained. To still further break up and intermix gas and steam, I fitted the annular spaces with wood and pine shavings supported upon rings at intervals, in a very similar manner to Cleland's scrubber. This arrangement prevents undue compression of the material at the lower layers. Each of the tubes was fitted with shower-rings, by which a stream of water could be made to descend upon the material; and provision was also left to enable the steam to be applied at different points, so as to carry forward, or prevent the passage of, any proportion of steam required.

I am pleased to be able to say that the results have been quite successful. Extended trial over many months with comparatively small and large air percentages, both with and without steam, leave no room to doubt the marked superiority resulting from its use. Careful records were kept of the effect of air alone during nearly twelve months' working; and during last season in applying steam, I kept, as nearly as circumstances would permit, to the same percentages at similar times of the year, in order to ensure parallel conditions.

The average results obtained are as follows:—

(1) During the summer months, with 2 per cent. of air and no steam, the gas purified per box averaged 3,000,000 cubic feet.

(2) Under similar conditions of make in summer, with 2 per cent. of air *and steam*, the average quantity purified per box was 7,000,000 cubic feet.

(3) During the winter months, with 0·8 per cent. of air only and no steam, the average life per box was 2,400,000 cubic feet.

(4) With steam added and 0·8 per cent. of air (under conditions otherwise the same), the life per box rose to 7,200,000 cubic feet.

I may mention that the oxide used in these trials contained from 36 to 40 per cent. of sulphur; and the gas on entering the purifiers while under steam was at a temperature of from 90° to 100° Fahr. The efficiency of the oxide in each box was raised by the help of steam from twice to three times its normal value—the greatest increase of efficiency being obtained in winter, when ordinarily, by reason of increased flow and low temperatures, the efficiency is generally lowest.

The specific points and advantages arising from the addition of moisture in this way may be briefly enumerated as follows:—

(1) The steam supplies the necessary moisture to preserve the activity of the oxide.

(2) The oxygen of the air supply seems, as Dr. Thorne suggested, to possess far more active properties under the influence of moisture. At any rate, a comparison of statements 1 and 2 or 3 and 4 singularly confirms this.

(3) Back-pressure from hardening or caking is absolutely stopped. This I attribute to the prevention of the drying-up effect, and also to the undoubted fact that the sawdust and woody fibre in the oxide swells considerably, thus tending strongly to disintegrate the mass, rather than allow it to bind.

(4) The high temperature of the ingoing gas, particularly in a humid condition, is distinctly favourable to oxidation, and to the chemical reactions generally.

(5) The addition of heat in this way is of great importance in winter, counteracting most satisfactorily the inert action of the oxide under severe cold, prolonging the life of the box, and enabling far greater dependence to be placed on the purifying operations.

* See JOURNAL, Vol. LIV., p. 116.

I am quite aware that, to render this paper more complete and worthy of your acceptance, I should embrace within it extended statistical reference to the exact analysis of the oxide and of the gas, before and after operations, together with information as to the actual amount of water used, the purifying area, and similar details. But I am placed at some disadvantage in being called upon to supply a paper at very short notice; and I am consequently unable to deal so fully with the matter as could be wished. This detailed statistical work is not yet ready; and as my trials are still progressing, I think, perhaps, it would be better to include the details in some future paper—that is, if the subject is thought worthy of a further hearing—though I am quite willing to give to the meeting now any information in my possession likely to be of assistance.

By giving the results under exactly parallel conditions, and at similar times of the year, one is placed in a better position for judging of the value of my contention. I believe that, when rightly administered and rightly understood, air applied in small proportions will be found of more value than the larger doses now are, which are often administered under unfavourable conditions. With careful attention, we may, perhaps, remove to some extent the discrepancy between air and oxygen.

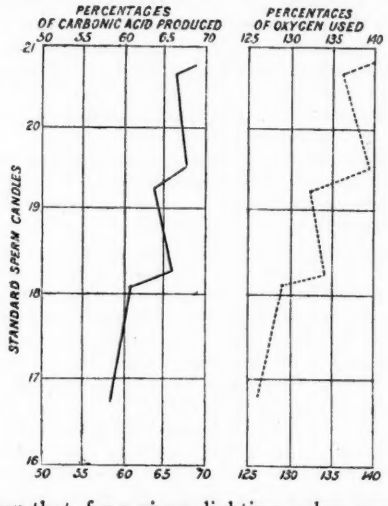
SOME ANALYSES AND LIGHTING VALUES OF ENGLISH COAL GAS MADE DURING THE YEAR 1891.

By William Foster, M.A., Professor of Chemistry at the Middlesex Hospital, London.

Through the courtesy of several gas engineers, I have been enabled, during 1891, to take samples of coal gas manufactured by them in different parts of England. The lighting value of each of the samples taken was determined at the time by a trained, experienced, and distinct operator. The conditions under which the samples were tested were also precisely similar. An open-bar photometer of the same length was employed; the burner was the standard Board of Trade Argand; the standard of light was sperm candles used in each case in the same way. The only exception is a sample of gas taken from the supply to my own laboratory. This was tested in an open-bar photometer by means of a Methven screen, instead of sperm candles. All the lighting values, expressed in sperm candles, have been corrected for deviations of the gas from standard conditions of temperature and pressure.

The methods of analysis adopted have been, in all essential particulars, those used and described by Dr. Percy Frankland, in his paper read before the Chemical Society in 1884.* Herewith are appended tables of the results obtained. In addition to an account of the proximate constituents of the samples, I have furnished a statement of the average molecular composition of the heavy hydrocarbons—the hydrocarbons removeable by the action of fuming sulphuric acid. There is also a statement of the volume of oxygen needed for the complete combustion of a given volume of each gas; and the volume of carbonic anhydride resulting from such combustion. Four of the seven samples which are the subject of this communication contain sensible quantities of nitrogen; and it is to certain considerations arising from the presence of this nitrogen that I first desire to direct attention.

Dr. Frankland and others have shown that, within the limits reached by the figures of my experiments, nitrogen, in a mixture of coal gas and nitrogen, reduces the lighting value of the coal gas in simple proportion to its volume in the mixture. On this basis, I have calculated what the lighting value, the amount of oxygen consumed, and the carbonic anhydride produced would be, were the gas freed of its nitrogen. The numerical results are given in Table II. On expressing the same figures diagrammatically, where lighting values are represented by abscissæ, and percentages of oxygen and carbonic anhydride by ordinates, the curves obtained are characteristic. It will at


PERCENTAGES OF CARBONIC ACID PRODUCED
50 55 60 65 70
PERCENTAGES OF OXYGEN USED
125 130 135 140
STANDARD SPERM CANDLES
21 20 19 18 17 16
50 55 60 65 70
125 130 135 140

once be seen that, for a given lighting value, more carbon vapour is needed in cases where nitrogen was originally present than when absent. Irrespective of the condition in which the carbon exists in the gas, the presence of the nitrogen is associated with a lower specific illuminating value per unit of carbon. From an inspection of the figures

* See Journal, Vol. XLIV., p. 17.

Table I.

Reference Number of Sample.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
Carbonic acid gas	..	0·47	0·32	0·53	..	..	..
Carbonic oxide	7·00	6·58	7·58	7·40	6·01	6·51	5·60
Heavy hydrocarbons ($C_n H_m$)	4·35	5·84	4·62	5·93	5·69	6·33	7·88
Marsh gas	35·12	35·93	36·33	33·32	37·80	37·66	37·74
Hydrogen	50·18	41·11	43·65	38·38	40·06	49·10	46·55
Oxygen	0·61	0·36	0·40	0·57	0·44	..	..
Nitrogen	2·52	9·71	7·10	13·89	10·50	0·40	4·00
	99·78	100·00	100·00	100·02	100·50	100·00	101·77
Carbon density of heavy hydrocarbons	3·20	3·00	2·53	2·80	3·26	3·14	2·57
Hydrogen density of heavy hydrocarbons	5·80	5·40	6·80	6·10	4·40	5·38	4·30
Oxygen needed for complete combustion of 100 volumes original gas	122·32	122·35	120·05	120·19	124·60	132·10	131·90
Carbonic acid produced by combustion of 100 volumes of original gas	56·88	59·82	56·35	58·50	61·60	63·92	64·38
Lighting value per 5 cubic feet per hour in standard sperm candles	16·30	16·60	16·80	16·84	18·50	19·10	20·00

Table II.

The following figures have been obtained by calculation from the foregoing. They furnish the carbonic anhydride, oxygen, and lighting value, on the assumption that no nitrogen is present in the individual sample.

——	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
Oxygen needed for 100 volumes of nitrogen-free gas	125·98	134·48	129·41	139·42	139·55	132·60	136·12
Carbonic acid produced by 100 volumes of nitrogen-free gas	58·58	65·80	60·51	67·86	69·00	64·20	66·44
Lighting value per 5 cubic feet per hour in standard sperm candles of nitrogen-free gas	16·80	18·26	18·05	19·53	20·72	19·20	20·68

of the analyses, I am unable to account for this reduction in the lighting value of the carbon.

The experiments which have been made by other workers on the reduction in lighting value of oal gas when diluted with nitrogen, have been made with purified gas; and, therefore, any reasoning based on such experiments can only be applied in a qualified way when considering the effects of nitrogen introduced as atmospheric air during the process of manufacture or purification. For my present purpose, the introduction of air may be considered under four heads—

1.—As air drawn into the retort through undue "exhaust."
2.—As air intentionally introduced while the crude gas is hot, and containing hydrocarbon and tarry vapours.
3.—As air introduced after cooling and "scrubbing," but prior to purification proper.
4.—As air accidentally introduced during the change of purifying material.

The samples are practically free from oxygen; and therefore no air has been accidentally introduced (4). Air is not used for purification in the works from whence these samples came. Hence origin under heads (2) and (3) can be neglected. I therefore infer that air has been drawn into the retort.

For some time I have maintained, on general considerations, that the influence of nitrogen on the lighting value of coal gas would most probably vary with the point at which air is introduced in the manufacture—say, in the four supposed cases already given. I was prepared to find an increase in the amount of carbonic oxide when air enters the retort; but that is certainly not shown in these analyses, even when allowance is made for the diluting effect of a given volume of nitrogen. I ought, perhaps, to point out that the quantities of carbonic oxide in all the samples is considerably greater than those given in several recently published analyses of coal gas.

Several attempts have been made to assess the lighting value of combustible gas by chemical and physical processes, apart from the use of a photometer. The specific gravity of the gas is a rough guide to the lighting value, if one knows the way in which the sample has been manufactured and purified. The diminution in volume caused by the action of bromine furnishes useful information. The determination of the volume and character of the heavy hydrocarbons is a third method; but, for strictly accurate purposes, all such methods are subordinate to that of the direct measurement of the light by a photometer. However, they have their uses.

An inspection of the diagram showing the relation between lighting value, oxygen consumed, and carbonic anhydride produced, will, I venture to think, lead to the conviction that a knowledge of the two latter factors, in the case of an analysis of illuminating gas, will enable one to assess the lighting value more accurately than any of the chemical or physical processes previously referred to—that is, when the lighting value comes within reasonable limits. Further data are, of course, necessary.

I draw the following inferences from these experiments:—

1.—That the ingress of air at the retort in gas manufacture lowers the specific lighting value of the carbon.
2.—That a consideration of the quantity of oxygen consumed, and the quantity of carbonic anhydride produced by an ordinary sample of coal gas, is a valuable guide to its approximate lighting value.
3.—That the quantity of carbonic oxide in these samples is much in excess of that attributed to similar gas by recent workers.

Addendum.—Since the foregoing paper was written, I have had occasion to employ coal gas for quantitative heat experiments where means for testing its lighting value were not available. A sample taken from bulk in a test holder gave on analysis the following data:—

Carbonic anhydride	=	56·70 per cent.
Oxygen consumed	=	120·00 "
Nitrogen in the original gas	=	2·38 "

I put the lighting value at about 16·3 candles. The official testing-place was closed on the occasion of my experiments; but the engineer of the works supplying the district informs me that tests made by the company's officials on that occasion went up to 16·5 candles.

It will be in the recollection of some of my hearers, that in the autumn of 1889, I made an examination, both chemically and photometrically, of coal gas manufactured by the Dinsmore process at Widnes. Some of the points brought out in that inquiry were certainly novel. The lighting values were determined by the Sugg "G" Argand—not the London Argand, such as has been used in the experiments described herewith. Fortunately the chemical analyses were made with all the care and experience I could command; and I can refer to them with confidence. There were three samples, two being so-called Dinsmore gas, and the third a mixture of ordinary and Dinsmore gas. The data obtained were as follows:—

Description of Gas.	Percentage of Carbonic Acid produced.	Percentage of Oxygen used.	Percentage of Nitrogen in Original Gas.	Lighting Value in Candles by the "G" Argand.
Dinsmore I.	63·12	130·6	·60	21·8
" II.	68·44	136·5	·59	22·3
Mixture (town gas)	58·70	120·3	1·10	18·6

According to the diagram before you, the lighting values of these gases with the London Argand would be about as follows: No. I., 19 candles; No. II., 21 candles; Town gas, 16·8 candles.

At the time of publication of the Widnes experiments, the extraordinary low specific gravity of the Dinsmore gas was a matter of public comment. I then called attention to possibilities in the *quality* of the carbon molecules affecting the result. Last year I gave the Institute an account of experiments connected with this part of the subject. I am now enabled to put before the Institute evidence of a different order—namely, that there was in the gas the quantity of carbon vapour necessary to constitute a gas of high lighting value—higher, in fact, than can be explained by the previously accepted data based on a mere consideration of the specific gravity.

Disputes between gas companies and their supervising authorities on the subject of the lighting value of the gas of the district, are not unknown. There was some evidence recently given before a Parliamentary Committee on the lighting value of the gas supply of a well-known borough. The variations in the lighting value were alleged to amount to several candles—say, from 14 to 18. My contention is that such alleged variations cannot occur without a chemical analysis, on the lines indicated in this paper, disclosing the real character of the gas supplied, and its approximate lighting value. Tests of gas supplied on a particular date cannot be verified; but samples of gas used at the time can always be reserved in sealed glass tubes, and the character of the gas subsequently ascertained. Much misunderstanding would, I venture to think, be avoided by such a course of procedure. In any case my proposition makes it possible for an independent observer to revise the autocratic dictum of a gas examiner by fresh experiment; and, in these days of constitutional government, that is worth something.

DIFFICULTIES IN TANK CONSTRUCTION.

[*Second Paper*]

By Thomas Newbigging, of Manchester.

Two years ago I contributed to the "Proceedings" of the Institute a paper with a title similar to the present one, in which the difficulties of bad ground—of soft, yielding and sliding clay, sand, and silt—were dealt with. In the paper which I have the honour to present to you to-day, I propose to take up the question of the water difficulty—the difficulties attendant on the presence of water in the excavated ground, and also some of the effects of extraneous water.

The first thing to be done, in determining the site of a tank, is to sink a well or shaft in the vicinity, or to make a number of borings on or near to the site, in order to ascertain the character of the strata in which the excavation for the proposed tank has to be made. If the ground in the immediate neighbourhood is clear of other tanks or buildings, it is not a matter of serious concern to find that a bed of sand, full of water, has to be encountered. To overcome a difficulty of that kind in such circumstances, is chiefly a question of pumping power. Piling also might be resorted to, and the free use of concrete, in case there was a possibility of the water being removed by pumping from underneath the tank at any future time.

But, on the other hand, if there are adjacent structures which it is unwise to run the risk of damaging, then it is well to be chary about pumping the water from the underlying sand and gravel. In such event, it is almost a matter of certainty that the removal of the water, accompanied also by the removal of a large proportion of the sand along with it, will cause subsidence of the ground in the vicinity, with consequent and possibly irreparable damage to the structures upon it. The safer and more prudent thing to do in such a case is either to abandon the site for another, or, if that cannot well be done, to construct the tank either wholly or partially above-ground, and of cast or wrought iron plates.

Assuming that the site for a gasholder tank has been finally settled; that it has been decided the tank shall be constructed of masonry (which term includes stone, brick, and concrete, or a combination of these); that it has been ascertained by boring that water is present in objectionable abundance in the substrata to be pierced—the first thing to be done is to sink a well or sump, 3 feet to 4 feet in diameter, at a convenient distance from the circumference of the proposed excavation. This should be lined with open unmortared brickwork (technically called "steining"), to allow of the free percolation of the water into the sump or well through the joints of the lining. Into this, when the sinker has reached the water-bearing strata, he conveys the suction-pipe of the pump, puts the latter in operation, and clears out the inflowing water to enable him to proceed with his work. This well is carried down to a depth of 3 feet to 5 feet (depending on the volume of water present), below the bottom of the intended excavation, and is then paved with bricks set in cement. If the strata are of uniformly open character—consisting, say, of a mixture of gravel and sand—one sump will be sufficient to clear the ground of water; otherwise, if it is not uniform, but barred by intervening clayey deposits (not an unusual thing), and even by solid-bedded sand—for this sometimes is almost as impervious as clay—it may be necessary to drain the water to the sump, or even to put down two or more sumps outside the ground operated on. Duplicate pumps should be provided where the inflow of water is very great. With these arrangements completed, the work of excavating and building can be proceeded with unhindered by the presence of any undue amount of water.

In the course of my practice, the excavation for a tank of which I was Engineer was chiefly through hard sandstone rock, the layers of which had been tilted up into almost the vertical position. This was fissured and cracked in all directions; and through the crannies, water bubbled up in numberless springs. Although one side of the adjacent ground was at a lower level than the tank bottom, it was impossible, by any reasonable expedient, to draw off the water from the outside. Possibly, by sinking a shaft to a considerable depth, it might have been accomplished. But considering the nature of the strata, that would have been costly; so I resorted to other means to overcome the difficulty. It is not an easy thing—in many cases it may be pronounced to be impossible—to choke out water from a tank from the inside. In puddling the bottom of the tank in question, and covering the puddle with a bed or layer of concrete, the springs were by no means closed; and though they were reduced in number, the flow of water was still quite as plentiful as before. Assuming that the pressure in these springs was sufficiently great to have overcome the pressure of the head of water in the tank when the latter was full, there would have been no objection to leaving them to flow at their own sweet will. But that was a risk which it was not prudent to run. The head of water in the tank would probably have more than counterbalanced the pressure of the springs; and where water can enter, it can as easily make its exit. The plan which in this case I adopted for making the tank water-tight, was to train or drain the different streams of inflowing water to one point by cutting a trench round the side of the bottom where the springs occurred, and laying therein strong 3-inch drain pipes, which in turn were carefully protected by a covering of strong concrete. The springs usually occur at, or near to, the base of the mound or dumpling left in the tank bottom; so that it is easy to gather them together by a drain and convey the water all to one convenient point. I had now got only one stream of inflowing water to deal with; and at this point I placed a 3-inch cast-iron stand-pipe, 3 feet in length, closed by a valve at its upper end, and the flanged foot secured by four Lewis bolts let into a base-stone 18 inches square and 9 inches thick, through the centre of which a hole was drilled. This stone was let into the floor slightly below the level of the concrete surface; and a cavity was left underneath it. From this stand-pipe, the inflowing water was pumped to relieve the pressure on the bottom till the cement in which the stone was bedded had set hard. I ought to mention that, in the side of the stand-pipe, at distances of 9 inches apart, I had three $\frac{3}{4}$ inch holes drilled. These were left open, to allow the water to issue from them without rising to the top. As the filling of the tank proceeded, these holes were each carefully plugged as the water rose above them; then the valve on the upper end of the stand-pipe being closed, the filling with water was completed—the tank proving to be perfectly water-tight.

Another method sometimes adopted, instead of using a stand-pipe as described, is to carry the drain right through the tank wall at its base, thus making an outside exit for the water. I prefer the stand-pipe, however, as being more self-contained and certain in its action. It sometimes happens that, without previous indication of its presence, the pressure of surrounding water will, in the course of construction, blow a hole or holes in the tank bottom. If so, the best thing is to let it blow; let it have free vent until all is completed and the tank ready for water, then apply the stand-pipe as described.

In another instance in my own practice, I had to construct a tank the line of circumference of which came close up to the side of a retaining wall bounding a considerable stream. In this case, the excavation having to be carried close up to the wall, the latter was laid bare for about 30 feet of its length; and as the cutting had to be taken about 6 feet below the level of the water in the stream, the rush of water through the interstices of the wall would have been fatal to the operations. Accordingly, to shut out the water, I constructed a wall of wooden sheet piling—made a cofferdam, in fact—60 feet in length; and the wooden piles forming one side of it were shod with iron, and driven (most of them) 12 feet into the bed of the stream. They were then bound together at their upper ends by a horizontal beam bolted thereto, and anchored at distances 10 feet apart with long bolts passing through the retaining wall. The space between the piling and the stone wall was 2 feet in width, and was hand-dredged to a depth of 10 feet below the water level. This space I had carefully filled in to above the stream level with stiff clay puddle, well rammed down. The work was eminently successful; and it was found an easy matter to cope with any water from the stream that reached the excavation, either from beneath or from beyond the two ends of the cofferdam.

The presence of water in an excavation is not always objectionable, unless it be excessive in volume. For example, in excavating through stiff clay, it renders the work of the labourer much easier than if the ground is dry and hard. Those who have had experience in shifting boulder clay, will readily endorse this view. Strata of this character are often so hard and parched and intractable as to require blasting to facilitate removal.

Avoid puddling a tank-bottom in wet weather, especially if the bottom is in the form of a mound or cone. Uniformity of consistence in the puddle is of more importance here than against the outside of the walls, for the obvious reason that the bottom has to bear the pressure of the water when the tank is filled. If one portion is well consolidated and firm and another soft and yielding, the concrete covering is liable to crack and split open, owing to the unequal sustenance. It is almost impossible to preserve this necessary uniformity with water coursing down the slope of the mound; the puddle becoming sodden and sloppy. And here I may remark that the fact that equal sustenance is of such importance, also proves the necessity of having the clay covering on the bottom of one uniform thickness all over. Even the deeper excavation made to receive the horizontal portions of the inlet and outlet pipes should have a solid concrete filling, allowing for just a like thickness of puddle above them as over the other parts of the apron and cone.

I do not think it is a wise thing to test the tightness of a tank with water immediately on completion. Better wait till the holder is finished, in order to give the puddle and cement time to set before subjecting them to the heavy pressure of water. I have known several instances of the

splitting of tanks due to this premature filling with water. Further, before filling a tank with water for the first time, the puddle and backing behind the wall should be carefully watered—by means of a hose-pipe, if possible—for several days before the filling is begun, and also during its progress. This promotes consolidation of the backing.

Finally, I have spoken of "difficulties," so called. But there are really no difficulties at all; or if there are, they are not insurmountable. They are all to be overcome by skilful resource, coupled with judgment, determination, perseverance, and suitable appliances.

THE MURDOCH MEMORIAL LECTURE.

A CENTURY OF WORK ON THE DEVELOPMENT OF LIGHT FROM COAL GAS.

By Vivian B. Lewes, F.I.C., F.C.S.,

Professor of Chemistry at the Royal Naval College, Greenwich.

The hundred years which have elapsed since Murdoch made his greatest discovery, and illuminated his house at Redruth with coal gas made in an iron kettle, have taught us many lessons; and by no means the least important chapter in the history of this century is the rapid growth in our methods, not only of making gas, but of burning it. In spite of all that has been learnt, however, we are only on the outskirts of a real knowledge of the changes which give us our great gaseous illuminant; and although a century of experiment has taught our gas managers the best coal to use, and the best methods and temperatures for producing gas from it, we are still ignorant of the exact nature of the hydrocarbons present in the coal, which, under the influence of destructive distillation, yields the gas, and also of the changes which result in the complex residue we know as tar, and the gaseous mixture which, forms the coal gas itself. The questions still to be answered with regard to coal gas will take long years of research for their elucidation; and I propose to-day to devote myself to a discussion of the methods we employ for the generation of the light from the gas, and to the facts we have learnt as to the causes of luminosity in flames, rather than to trespass upon a subject which still contains so many unknown factors.

When Murdoch, in 1792, first made coal gas in his Cornish home, he burnt it as it escaped from the open end of a pipe; but, quickly perceiving that a spreading of the flame gave a better light with a decrease in consumption, he fitted a thimble over the end of his tube, and, by boring small holes in the thimble-head, caused the gas to burn in several small jets. But as his experiments progressed, the form of his burner was modified, until in 1807, when fitting up the works of Messrs. Phillips and Lee, in Manchester, he used two forms of burner—the one a rough Argand, and the other "a small curved tube with a conical end, having three circular apertures or perforations, about a thirtieth of an inch in diameter, one at the point of the cone, and two lateral ones through which the gas issued, forming three divergent jets of flame somewhat like a fleur-de-lys."* This latter burner, which, from the shape of the jet, received the name of the "cockspur" burner, gave a light equal to 2¼ mould candles of six to the pound; while the Argands used developed a light equal to four candles of the same description. The Argand burner had been in use for the consumption of oils for some years before the introduction of coal gas; and in its early form consisted simply of two concentric tubes fixed at the required distance apart; the coal gas being fed in between them. Soon, however, the idea arose of closing the open circular slot by a metal ring pierced with holes so as to give a circle of small jets; and even prior to 1816 the main principles of our present Argands were to be found in the burners in use. It was about 1816 also that the cockspur burner became converted into the cockscomb, and then the batswing—thus marking a distinct advance in the method of burning the gas, as by spreading the flame out into a thin sheet, instead of having it in a solid mass as in the jet burner, the air was more uniformly and readily supplied to the burning gas, and the increased temperature of the flame due to the more perfect combustion increased the light-giving power of the burner to nearly that of the Argands then in use.

In 1820, Neilson of Glasgow, whose name will always be remembered as the discoverer of the hot blast in iron smelting, found that, by allowing two flames to impinge upon each other, an increase in luminosity was obtained; and, after several preliminary stages, the union-jet or fish-tail burner was produced, in which two holes bored at the necessary angle in the same nipple caused two jets of gas to impinge upon one another, so that they mutually splayed themselves out into a flat flame. The shape of the batswing flame was a very wide flame of but little height, while the fishtail flame was much higher and narrower; and although the service yielded by the batswing for each foot of gas consumed was no better than, if it was as good as, that given by the batswing, yet its shape, which made it less affected by draughts, and enabled a globe to be used with it, ensured a greater meed of success for it than the batswing burner had secured.

The next twenty years was a period of improvement and gradual perfecting of the Argand and flat-flame burners—the influence of pressure and regulation of the flow of gas to the burner being gradually realized and arranged for; whilst other structural improvements were introduced later by Sugg, Bray, and others.

In the year 1854 a new and important departure was made by the Rev. W. R. Bowditch, who conceived the idea of utilizing heat, which otherwise would have been lost, to raise the temperature of the air supply, by enclosing an Argand burner by a double glass cylinder so arranged that the air had to pass down between the glasses and in its passage became highly heated. The burner itself was never a commercial success, as the high temperature so rapidly acted upon the inner glass as to render its frequent renewal necessary; but it marks an important era in the history of lighting by gas, as in it we find the inception of the regenerative lamps which during the last thirteen years have revolutionized the methods for the production of high illuminating values from gas. The first successful application of the principle was by Mr. F. Siemens, in 1879. The results he achieved were so far in advance of any previously obtained, that others followed in his footsteps; and Clark, Grimston, Bower, and Thorp all contributed burners in which the same principles received slightly different application. These in turn have given rise to the host of others which not only add to our power of illumination, but also threaten to increase business in the Law Courts.

About the same time that the regenerative burner was struggling into prominence, Mr. Lewis brought out a burner in which the coal gas was consumed mixed with air, as in a Bunsen burner; and the flame was then urged, by an artificial blast, against a cone of fine platinum wire, which being heated to incandescence gave a very high candle power per cubic foot of gas consumed, and was thus the forerunner of the Welsbach, Clamond, and other incandescent lights.

Having traced the gradual genesis of our present burners, we must now glance at the theories which have been from time to time advanced as to the causes that endow a flame containing those compounds which we know as hydrocarbons with the properties of emitting light; for, until we have some conception of the causes which give rise to luminosity in a flame, it is impossible to arrive at any idea of how far further improvements may be expected to go, and in what direction to look for them. While this century was still in its "teens," Sir Humphry Davy undertook that great research which culminated in the invention of the Davy safety-lamp; and during this work he made some observations which caused him to enter upon further researches as to the cause of luminosity in flames. These were embodied in his historical papers published in the Transactions of the Royal Society for 1817. These researches led him to the conclusion that the luminosity of flames is due "to the decomposition of part of the gas towards the interior of the flame, where the air is in smallest quantity, and the deposition of solid carbon, which, first by its ignition and then by its combustion, increases in a high degree the intensity of the light." Davy's explanation remained unquestioned until 1868, when Dr. Frankland showed that flames such as that of hydrogen in oxygen could be rendered luminous by compressing the oxygen, and that such a flame contained no

* Murdoch's Royal Society Paper, 1808.

solid particles, as required by Davy's theory; also that the intense light emitted by phosphorus burning in oxygen, or arsenic in oxygen, could not be due to this cause, as the temperature of the flame was higher than the volatilizing points of the products—phosphorus pentoxide and arsenious trioxide. The combustion of phosphorus in oxygen, for instance, gives a temperature of over 1300° C.; while the oxide that is formed volatilizes at between 800° and 900° C.

Dr. Frankland's research showed beyond doubt that a flame containing dense vapours might be luminous; but he failed in proving, as he claimed, that the luminosity of a coal-gas flame was due to dense hydrocarbon vapours heated to incandescence, and not, as Davy had stated, to separated carbon particles at a high temperature. This paper gave rise to a large number of other researches and communications on the subject, which greatly increased our knowledge of the actions going on in flames and the various causes which affect them. Dr. Frankland not only showed that flames might be luminous without containing solid particles, but advanced the theory that the luminosity in the flame of a burning gaseous hydrocarbon was due to dense hydrocarbon vapours; and he further pointed out that the soot deposited upon any cool substance held in such a flame contained hydrogen. To this W. Stein replied, showing that the deposited soot contained less than 1 per cent. of hydrogen, which was therefore probably only occluded by the carbon; and also that, if it had been present as a vapour in the flame, it ought, on being heated to the same temperature as the flame, to be once again volatile, which it undoubtedly is not. In the year 1874, Soret attempted to show that the cause of luminosity in flame really does depend upon the presence of solid particles, by focussing the sun's rays upon a luminous flame, and examining the reflected light by means of a Nicol prism. Rather later, Burch pursued the same line of research, but he employed the spectroscope for his examination of the reflected light; while quite lately, Professor Stokes, following the same line of research, has confirmed their results, all of which point conclusively to the presence of solid particles in those flames which owe their luminosity to the combustion of hydrocarbons. Heumann also, in 1876, pointed out that hydrocarbon flames gave a distinct shadow, which is only the case when solid particles are present.

It is impossible to gainsay or refute the mass of evidence which has been adduced upon this point; and we must accept as proved beyond doubt that the luminous portion of hydrocarbon flames contains solid particles of practically pure carbon, which, partly by their own combustion and partly by the combustion of the other gases present, are heated to incandescence, and contribute at any rate a very large proportion of the luminosity of the flame. In the present state of our knowledge, I should be sorry to say that the luminous portion of a flame does not contain some extremely heavy hydrocarbon vapours, and that these may not, under the influence of intense heat, add to the general effect. But at present I have been unable to detect their presence, while the presence of solid particles has been abundantly proved. Several attempts have been made to trace the chemical changes going on during the combustion of the flame gases. Hilgard, Blochmann, and Landolt did this by withdrawing portions of the gases from different parts of the flame, and analyzing them; but no definite conclusion was arrived at as to the actions which culminated in the liberation of the all-important carbon particles. For some time past I have devoted attention to this point, and, with the aid of my assistants, have, I think, found the key to the actions which are going on within a luminous flame—actions far more complicated than were imagined or provided for by the older theories, and yet in themselves beautifully simple.

In our coal gas, we have a mixture of hydrocarbon gases and vapours diluted with hydrogen and small quantities of carbon monoxide; while such unwelcome impurities as carbon dioxide, nitrogen, and oxygen also exist in traces as small as the gas manager's skill can make them. The composition of coal gas varies considerably with the temperature at which the retorting of the coal takes place; and the gas made by one company may vary from time to time within fairly wide limits. The composition of the London gas at the present time is a study of considerable interest, as it reveals occasionally signs of the methods of enrichment which are being tried at some of the principal works:—

South Metropolitan Gas.

	1890		1892
Hydrogen	57·08	..	52·22
Unsaturated hydrocarbons	4·38	..	3·47
Saturated hydrocarbons	33·99	..	33·76
Carbon monoxide	2·63	..	6·23
Carbon dioxide	0·79	..	0·60
Nitrogen	0·96	..	3·23
Oxygen	0·15	..	0·49
	100·00	..	100·00

In all our gas-flames we can trace by the eye two principal zones, and at least one subsidiary one. There is the non-luminous zone just above the burner, and above it again is the all-important area of luminosity which gives the value to the flame; and between this and the air comes a thin non-luminous mantle which marks the confines of the flame. The inner non-luminous zone of the flame has always been looked upon as the zone of non-combustion, and but little attention has been paid to it by the chemist; while the gas engineer has often yearned to decrease its size, and so increase the zone of luminosity, but has so far found that regeneration is the only practical method of doing so. If we are to increase the amount of light which it is possible to obtain from a gas-flame, it is manifest that this portion of the flame offers us the most promising field for research. My experiments upon flame gases show that as the coal gas comes from the burner into the air, the hydrogen, on account of its lightness and diffusive power, finds its way to the exterior of the issuing gas, and burns first; combining with the oxygen of the air to form water vapour. Next in order of rapidity of burning is the methane, or marsh gas, which is also the lightest gas, next to hydrogen, present. The hydrogen in the marsh gas burns to water, while the carbon burns partly to carbon dioxide and partly to carbon monoxide, according as the marsh gas molecule at the moment of combustion is in an excess or deficiency of air. The carbon monoxide is generated in the flame, partly by incomplete combustion and partly by the action of water vapour on some of the heavy hydrocarbons, so much more quickly than it is burnt, that it increases in quantity up to the top of the non-luminous zone, although itself a combustible constituent of the gas.

The combustion of these two gases on the exterior of the lower portion of the escaping coal gas creates intense heat, and bakes the remaining portions of the gas in the non-luminous zone; and this causes important changes to take place in the heavier saturated and unsaturated hydrocarbons present. These consist chiefly of ethylene, benzene, propylene, butylene, and crotonylene, as representatives of the unsaturated hydrocarbons; methane, ethane, propane, and probably butane, as representatives of the saturated. With the exception of the methane, these hydrocarbons are all of considerable density; and the denser they are, the smaller is their tendency to find their way to the exterior of the flame. Only the straggling molecules from their ranks do this; so these bodies decrease far more slowly in the earlier portion of the flame than the lighter gases with which they are mixed. These hydrocarbons, however, are gradually altered by the heat to which they are subjected; and they all show a tendency to break up into acetylene at a temperature a little over 1000° C. (2120° Fahr.), so that by the time the top of the non-luminous zone is reached, 81 per cent. of the still existing hydrocarbons have been converted into this body, and the luminosity of the flame commences immediately afterwards. Acetylene is a clear, colourless gas, with a strong and disagreeable odour. It consists of 24 parts by weight of carbon, combined with 2 parts by weight of hydrogen. It is one of those bodies which during their formation take in heat instead of giving it out; and it is therefore called an "endothermic" compound. Such substances are especially liable to decomposition, as this is accompanied by a rise in temperature instead of, as is the case with most decompositions, an absorption of heat. Acetylene is decomposed at between 1100° and 1200° C. into carbon and hydrogen, together with traces of higher hydrocarbons; while Berthelot has shown it to be so unstable that it can be broken up into carbon and hydrogen by detonating a percussion cap in it.

The next step in elucidating the cause of luminosity was to determine the temperature existing in the various parts of a flame; and as a flat flame offers a more convenient

surface for research than any other, the flame from a No. 7 Bray burner was chosen, and the temperature of the various portions was determined by a Le Chatelier thermo-couple. This consists of a piece of platinum wire, the end of which is twisted with the end of a wire made of platinum with 10 per cent. of rhodium. On heating this, a galvanic current is generated, which is made to pass through a reflecting galvanometer of special construction, and this deflects the needle. A ray of light falls upon a mirror attached to the needle, and is reflected on to a scale; so that, as the needle moves, a spot of light travels along the scale. The scale is graduated into degrees by plunging the thermo-couple into various media the temperature of which is known; and as the current generated is practically proportional to the temperature, it makes a very convenient arrangement for measuring high temperatures. Using this instrument, it was found that the temperature half-an-inch above the burner was 500° C. (932° F.), and steadily increased to 1200° C. (2192° F.) at the top of the non-luminous zone, luminosity commencing at 1200° C. (2192° F.). The highest temperature was found to be near the top of the luminous zone, where it reached 1368° C. (2462° F.). In no case is the temperature of the luminous portion of the flame less than from 1100° to 1200° C.

Taking the evidence which I have now laid before you, we may, I think, fairly fully explain the actions that take place in the flame, and lead to luminosity. As the gas leaves the jet, the hydrogen rapidly diffuses to the outer edge of the flame, and burns; the methane doing the same, but rather more slowly. The combustion of these gases raises the temperature 500° C. in the first half inch; while before another half inch has been traversed 1000° C. is reached, and the chemical changes in the hydrocarbons are progressing rapidly—the unsaturated hydrocarbons and higher members of the saturated hydrocarbons being rapidly converted into acetylene. If the temperature of the flame were not allowed to rise above 1000° C., this acetylene would be nearly all polymerized into benzene, naphthalene, and other more complex bodies, which would be slowly burnt up without liberation of carbon, and a non-luminous flame would result. This may be shown by holding a platinum dish against a luminous flat flame, when luminosity disappears; but it may be reproduced by heating the interior of the dish. In the case of a gas-flame, however, instead of remaining at 1000° C., the temperature rapidly rises to 1200° C., with the result that, instead of polymerizing into more complex bodies, the acetylene formed at once splits up into carbon and hydrogen, and the former, heated to incandescence by combustion, gives the luminosity. It is the attainment of this temperature that marks the limit of the non-luminous zone. If this were the only action, however, the luminous zone would be very short. But the bodies formed from the acetylene before 1200° C. was reached, and the methane, of which some still remains unburnt, are converted into acetylene at a still higher temperature—*i.e.*, 1300° C.; and this being reached near the top of the luminous zone, yields a fresh supply of carbon, and so increases the height of the light-yielding portion of the flame.

In producing the luminous flame, therefore, there are two main factors to be observed—first, to use such compounds as shall be most easily converted into acetylene; and, secondly, to attain as quickly as possible as high a temperature as practicable. The moment we have reached this point in our theory, we naturally think how this can be best done; and we find to our disgust that theory has only just caught up practice, as long experience has taught our gas managers that the olefines and unsaturated hydrocarbons are the most valuable illuminants in the gas, while our burner makers have slowly and by laborious steps found that by regeneration they can obtain the best results per cubic foot of gas consumed.

Some of my hearers will go beyond this point, however; and it may flash through their minds to ask: "If acetylene is the key to luminosity, and if this gas is formed by the action of high temperatures on the gas, why is it that retorting at high temperatures gives but a trace of acetylene, and ruins the illuminating power of the gas?" Simply because the heat which forms the acetylene also polymerizes that body into benzene, and still more largely into naphthalene, especially in the presence of carbon; and you know better than I do that high temperatures result in an increased yield of this body, or else, having formed acetylene, breaks it down to carbon and hydrogen, and that any attempts to increase the luminosity by superheating the gas must end in failure, as the action taking place in the flame is probably the only method by which this body can be so formed as to yield the desired results. In the flame it is formed and at once decomposed by the heat of combustion; in the retort it is formed at high heats, and yields but traces of benzene and naphthalene, which largely go into the tar, or condense where they are least wanted. Even if it were possible to charge gas with acetylene, it would be useless for practical purposes, as it is soluble in water and all other media, such as glycerine, which could be used in gasholders and meters. So that once more we come back to the fact that, in our gas-flame, Nature has provided the best methods for the carrying on of the actions which culminate in luminosity, and that the most likely field for improvement is in our mechanical treatment of the flame itself. This is also shown by the fact that in an ordinary gas-flame the luminosity is caused by something like 1·5 per cent. of acetylene liberated at the right spot; whereas double this quantity, mixed with a non-luminous gas like hydrogen, yields hardly any light-giving power to the flame, because by the time the temperature necessary for the splitting up of the acetylene is reached, it is nearly all burnt up without any liberation of carbon.

Regeneration, as has been before pointed out, increases to a very great extent the light yielded per cubic foot of gas This is due to two causes. In the first place, by increasing the temperature, the decompositions necessary to form acetylene and liberate carbon from it are hastened, and so the non-luminous zone is decreased in size, and a larger proportion of the gaseous hydrocarbons are converted into acetylene; and, secondly, by heating the inert nitrogen of the air supply, it prevents the withdrawal of so much heat, and raises the carbon particles, when liberated, to a brighter incandescence, and so yields a higher service. Through the kindness of Mr. Siemens, I have been enabled to determine the effect of regeneration on a flat flame, both as regards the diminution in size of the inner zone and the increase in luminosity. The flame, when cold, had a total area of 11 square inches, of which the luminous zone occupied 7·8 square inches, and the non-luminous 3·2 square inches. On regenerating this flame, the total area decreased to 10·2 square inches; but the luminous zone occupied 7·9 square inches, and the non-luminous zone 2·3 square inches of the space; while the illuminating power was increased 100 per cent.

The regenerative gas-burner, however, is by no means the most widely-used one; and initial cost and domestic inertia are such all-powerful factors, that the flat-flame burner is still the burner of the people. But great as have been the improvements effected in this class by our leading makers, the use of the flat-flame burner means several millions wasted annually—not to the profit of the gas manager, but simply in loss of light to the consumer; and as anything which could be done to increase the light-giving power of the flat flame would be an inestimable boon, you will pardon my spending a few moments in pointing out a direction in which, I think, attempts might be made to do this. In the passage of the heavy hydrocarbons up the non-luminous zone of the flame, a certain percentage must of necessity be lost by wandering into the part of the flame where combustion is taking place, and where they get burnt up without decomposition, and so are lost as far as any luminosity is concerned. The larger the inner zone, the greater will this loss be; so that if the inner zone can be by any means reduced in size, not only do we gain an increase in luminous surface, but a larger supply of carbon particles to yield light.

Some five-and-twenty years ago, a device for increasing the luminosity of a flat-flame, called "Scholl's platinum light perfecter," created a considerable amount of interest; and undoubtedly, while the perfecter was new, it caused a considerable increase in the amount of light emitted by the flame. The perfecter consisted of a thin slip of platinum fixed across the burner, and between the orifices of the jet, so that the two streams of gas impinged upon it, and afterwards mingled in the flame. The explanation always given of its action was that, in the far from perfect burner then in use, it perfected the combustion of the flame by breaking the rush of the gas; and that, had it been applied to a properly regulated burner

no gain would have resulted. This view is, to a great extent, supported by the effects of pressure upon the gain in light obtained by its use, as Mr. Rowden and Captain Webber found that the increase in light given by it varied from 30 per cent. with a pressure of 0·46 of an inch, to upwards of 200 per cent. with a small burner and a pressure of 0·84 of an inch. But although this was an important factor, a still more important one remained; and that this was so is shown by the fact that, after being used for a considerable time, the perfecter lost its power to a very great extent, which would not have been the case had its action been purely mechanical.

Platinum is a metal which possesses the property of condensing gases upon its surface, and rendering them chemically more active than when in their normal condition; so that if the condensed gases have a tendency to enter into chemical combination, the presence of the metal, especially when heated to a certain extent, will set up chemical action. That this is the case is clearly shown by heating a piece of platinum foil to redness, allowing it to cool until it ceases to be visibly hot, and then holding it in a current of mixed coal gas and air, when the metal at once becomes red hot, and often reaches a temperature at which the gas is ignited. This is due to its compressing the oxygen of the air and the hydrogen of the coal gas upon its surface, and bringing about their combination—an action which evolves great heat, and raises the platinum to incandescence, although the actual temperature necessary to ignite the gas may not be reached, as the heat required to do this is very great. In the perfecter, the strip of metal, besides regulating the force with which the two streams of gas impinged upon each other, was raised by this action to incandescence in a portion of the flame which otherwise would have been several hundred degrees cooler, and thus converted the hydrocarbons into acetylene, and by its superheating action reduced the size of the non-luminous zone. After a time, however, the platinum became attacked by the hydrocarbons of the gas, and the carbide of platinum formed ceased to have this regenerating action, and the perfecter lost its potency. It was this deteriorating action of the coal gas on platinum which I believe seriously militated against the success of the Lewis incandescent lamp, which was undoubtedly the most promising of its class, but which, for the reason I have given, soon lost its power.

By placing a platinum wire in the non-luminous zone of a flat flame, we can, if care is taken not to distort the flame, draw down the luminous zone to a considerable extent; and if a fine platinum gauze screen be placed on each side of the lower portion of the non-luminous zone, it acts in the same way as regeneration does, and gives a considerable increase in luminous surface. Another way in which the non-luminous and non-effective portion of the flame may be reduced is by increasing the rate of combustion at the bottom of the flame. Ten years ago, Sir James Douglass introduced his multiple Argand, in which a number of circular flames burnt one within the other, while a series of deflectors caused a sharp current of air to impinge upon the outer flames at their base; causing a very great increase in the illuminating effect produced per cubic foot of gas consumed. In this burner the outer layers of flame were sacrificed to create an intensity of temperature which should perfect the light-giving power of the interior layers; and by setting up this intense combustion at the base of the flame, the service of the burner was raised to 6 candles per cubic foot of 16-candle gas. A still better example, because more widely known, of the same thing is to be found in Mr. Sugg's "London" Argand, in which the metal cone round the burner plays the same part as the deflectors in the Douglass burner, although to a smaller degree, while the cluster burners also benefit to a certain extent by the increase of temperature which their arrangement brings about; and I cannot help thinking that if our burner makers will attack the question of improving the flat flame by thickening the flame a little, and introducing a suitable form of deflector to bring a current of air against the base of the flame, we shall soon be able to squeeze a couple of candles more service out of these trusty old servants, and thus add an iota more cheerfulness to our gas-lit cities.

The question of how far it may be possible to go in the extraction of light from gas, is a question so complex that I hesitate to even mention it; but I think that many things point to the best forms of regenerative burner having nearly reached the limits of practical possibilities. So that, in conclusion, it may be well to see in what other direction the development of light from coal gas may yet extend. The 4 per cent., or thereabouts, of heavy hydrocarbons, which in the ordinary combustion of coal gas yield the acetylene necessary for the liberation of the carbon particles which are essential for the production of luminosity, are so small in quantity, as compared with the constituents which in the burning of flame merely generate heat, that the idea naturally arose of the incandescent burner, in which, by admixture of air with the coal gas before combustion, a non-luminous but hotter flame could be produced and utilized for heating various refractory materials up to incandescence, so that they, and not the carbon, should emit the light. In burning coal gas from an open tube, the highest temperature attained is about 1100° C. (2012° Fahr.); while in the more perfect combustion taking place in a flat flame, 1368° C. (2462° Fahr.) is attained. But by mixing air with the gas before combustion, as in the ordinary Bunsen burner, until the mixture burns with a quiet and non-luminous flame, a temperature of 1500° C. (2732° Fahr.) is reached; while by increasing the quantity of air until the flame is on the point of flashing down in the tube, the temperature rises to 1630° C. (2966° Fahr.), or nearly 300° C. hotter than the luminous flat-flame. It is this high temperature which is taken advantage of to raise the various materials used in incandescent burners to the point at which they emit the required light.

In order to gain a relative idea of the service obtained per 5 cubic feet of 16-candle gas from the various classes of burner, choosing the best of each kind for comparison, we may take it (roughly) as being as follows:—

Service yielded by Various Burners per 5 Cubic Feet of Gas per Hour.

Flat-flame	12·5
Argand, ordinary	14·0
London Argand	16·0
Regenerative	52·5
Incandescent	70·0

A colleague of mine at the Royal Naval College—Professor Lambert—has been for some time past experimenting in his own house as to the cost of various forms of illuminating on a domestic scale; and his results, for actual working over a considerable period, he has kindly placed at my disposal. They are as follows:—

Annual Cost of Maintaining a Light of 48-Candle Power (say, 2000 Hours' Burning).

RESULTS OF TESTS UNDER PRACTICAL CONDITIONS.

GAS.

Argand Burners.

Three 16-candle lamps, each consuming 5 cubic feet of gas per hour	30,000 c. ft. of gas at 3s. per 1000 c. ft.	90s.	
	Renewals of chimneys	3s.	
			93s.

Regenerative Burner.

One small lamp, consuming 6 cubic feet of gas per hour	12,000 c. ft. of gas	36s.	
	Repair of lamp, &c.	5s.	
			41s.

Albo-Carbon Burners.

Two No. 2 Bray burners, each consuming 3½ cubic feet of gas per hour, carburetted with naphthalene	14,000 c. ft. of gas	42s.	
	52 lbs. of naphthalene, at 3d.	13s.	
			55s

Incandescent Burner.

One new large mantle, 48-candle power, burning 3½ cubic feet per hour	7000 c. ft. of gas	21s. 0d.	
	Renewal of mantles, 3 at 2s. 6d.	7s. 6d.	
	Renewal of chimneys.	1s. 6d.	
			30s.

PETROLEUM.

Large Lamp.

One 48-candle lamp, burning 1 gallon of oil in 28 hours	Oil consumed, at 7d. per gallon,	41s. 8d.	
	Chimneys, wicks, &c.	2s. 4d.	
			44s.

Small Lamps.

Four 12-candle lamps, each burning one gallon of oil in 84 hours	Oil consumed	55s. 6d.	
	Chimneys, wicks, &c.	2s. 6d.	
			58s

ELECTRIC.

Incandescent Lamps.

Three 16-candle lamps, each absorbing 56 Watts	Cost of current at 8d. per unit (1000 Watt-hours)	224s.	
	Lamp renewals, six at 3s. 6d.	21s.	
			245s.

The only remark which I have to add to this particularly interesting and useful table is that Professor Lambert has been extremely fortunate with his incandescent mantles and chimneys; while the regenerative lamp employed is manifestly too small to give anything approaching its maximum results. My own experiments would lead me to say that the incandescent and regenerative burners,

taking everything into consideration, are as nearly as possible equal in cost; each of them yielding the above amount of light for an expenditure of about 35s.

In the search, moreover, for the best method of generating light from coal gas, we must not overlook the quality of the light emitted. We should remember that the yellow light given out in the ordinary consumption of coal gas is eminently adapted for resting the eye, wearied by the actinic rays of the daylight; and that, although an intense white or bluish-white light is admirably adapted for picture galleries, and other situations where it is necessary to bring out delicate shades of colour, yet that in the living and working room such a light must in time affect the eyesight more or less. Incandescent lighting is still in its infancy; and it has yet to be discovered how to make a mantle or cone which will not deteriorate in use, and shall not be too brittle to withstand the jars of every-day work.

I have, in this lecture, attempted to place before you a general outline of the wonderful growth of our present methods for developing light from coal gas; and we may well be proud of the results of the work done in the past century. But is there no reverse to this picture? Has everything been done which might have been done to encourage and increase the demand for gas? The gas engineers and managers of this country may have been a little tardy in recognizing new principles; but their record is a noble one, and the one great mistake of the century does not rest upon their shoulders. For coal gas to take its proper place, it must be supplied at the cheapest possible rate; and all statistics show that the increase in consumption when the price of gas is low is very large indeed. The one thing which has more than anything else kept back the gas industry has been the fixing of the illuminating value at too high a figure. If a 14 instead of a 16 candle standard had been adopted here in London, an almost unbearable burden would have been taken off the gas manager's shoulders. Not one consumer in a thousand would have noticed any difference in the light—indeed, a little trouble on the part of the Companies in advising consumers as to the best forms of burner to use, would probably have resulted in an absolute gain; while the reduction in price consequent on the doing away with the need of enrichment, would have given an enormous impetus to the employment of gas as a domestic fuel.

At the close of the lecture, which was very warmly applauded,

Mr. HEPWORTH said it was impossible for anyone to do justice, in the time at the disposal of the meeting, to the brilliant lecture to which the members had just listened. He would, however, ask all present, more especially those members of the Institute who were old enough to remember the former lectures, whether in any previous experience they had had the pleasure of listening to one so lucid, so singularly clear, and so instructive as this had been. Professor Lewes had laid not only the Institute, but the whole gas profession under the deepest obligation; and he (Mr. Hepworth) had much pleasure in proposing a hearty vote of thanks to him.

Mr. J. M'GILCHRIST (Dumbarton) expressed his great pleasure in seconding the vote of thanks. He said he had never listened to a more excellent lecture, and had certainly never heard a better speaker. It was so excellent, in fact, that he did not think it would improve matters by saying anything more about it. They could only accord to Professor Lewes a very hearty vote of thanks; and he considered the Council should also be thanked for providing so able a lecturer.

Mr. W. SUGG said he did not rise to discuss the lecture, but only to support the motion. He had been carried back to the first meeting of the Institute; for the voice of Professor Lewes had certain intonations in it which recalled to his mind the voice he used to hear many years ago, when the progress of making gas was to a very great extent assisted by the lectures which were given annually. He thought it was a good augury for the success of the Institute in future that the Committee should have found a means of renewing this communication between them and the highly scientific body of chemists; and he hoped this experiment would be continued for many years. As Professor Lewes had said, they had been struggling for years in practice, and had not had anybody, up to the present, to tell them where theory and practice combined. He (Mr. Sugg) had worked for many years on this matter; and he acknowledged that, until he saw the lecturer's experiments with regard to acetylene, he never thoroughly understood the causes of the luminosity of a gas-flame. They had the same sort of general idea that Sir Humphry Davy had with regard to solid particles; but they did not know until that morning how those solid particles were converted into light. There was an idea about keeping the flame hot, or, as he used to contend, keeping the gas cool. It was a very difficult thing to do the one without the other; and certainly his opinion was that the gas, being kept cool before it reached the point of ignition, gave a very decided increase of illuminating power. But he afterwards found that the improvement arose from keeping the flame hot by substituting a non-conducting for a conducting material, so that the heat should be concentrated in the flame; and now they had heard the reason why this was so. He should like to have gone at some length into the points raised by the lecturer, though his criticism would have been entirely of a friendly character. But he would only say that this was a practical and theoretical lecture combined; and he hoped the results would not be lost to the gas industry.

Mr. D. BRUCE PEEBLES (Edinburgh) desired to express his special thanks to Professor Lewes for one single point he had put forward. At present, in Edinburgh, they were very eagerly contesting the question as to the maintenance of 28-candle gas; and Mr. M'Gilchrist was one of the strongest opponents of reducing the quality in Scotland. He (Mr. Peebles) hoped this lecture would have brought him to a different opinion; for it seemed that the future of Scotch gas managers depended on the lowering of the illuminating power. They were having electricity introduced in all shapes and forms; but the lecture they had just heard would prove most incontestably that gas had a great future before it. Electricity had been the friend of gas. It had promoted the improvement of burners; and wherever it was introduced gas had flourished.

The PRESIDENT, in putting the resolution said he should only like to say for himself that the combined theory and practice of Professor Lewes had opened their eyes to facts which they only saw dimly before, and many had not seen at all. If they carefully considered what had been said, many mistaken opinions, which had been passed off as having something in them, would be cleared away.

The resolution was carried by acclamation.

Professor LEWES thanked the members of the Institute for the kind way in which they had received the lecture. He could assure them that his labour on the subject was one of love; and he hoped before his working days were over that he should have been able to do some good, at any rate, to the gas industry.

The PRESIDENT then announced that Mr. R. B. Prosser had kindly placed at the disposal of the members some *fac-simile* copies of a letter written by William Murdoch in vindication of his character and claims. He believed it was Murdoch's only literary production, with the exception of his paper in the "Philosophical Transactions." A copy was given to Mr. Prosser by one of Murdoch's grandsons; and one was found amongst the papers belonging to the old firm of Boulton and Watt. He believed that Mr. Richard Tangye, of Birmingham, had another. But, apart from these, there were no others known to exist. The members were under a great obligation to Mr. Prosser for having placed these copies at their disposal; and he begged to propose that a vote of thanks be accorded to him.

The proposition was carried unanimously.

Masonic.—Those of our readers who were present at the Emergency meeting of the Evening Star Lodge, on Monday evening last week, for the reception of the masonic members of The Gas Institute by the President (W. Bro. Valon), will be interested to learn that a full report of the proceedings will appear in the *Freemason* and also in the *Freemason's Chronicle* on Saturday next.

The Use of Gas in Lighthouses.—A few evenings ago, an interesting experiment was made at Howth (Dublin) to test the powers of Mr. J. R. Wigham's new gas-burner for lighthouse purposes. It was exhibited through the "giant" lens, about which a paper was read at the Royal Dublin Society a few weeks since, as mentioned in the JOURNAL at the time. The lens was fixed in the experiment house near the Bailey Lighthouse; and the light in the latter was at full fog power, in order that a comparison might be made between it and the new light. The latter shone very clear, and the flashes were extremely bright and distinct. The Commissioners of Irish Lights witnessed the exhibition.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1197.)

AFFAIRS in the Stock Exchange during the past week have been extremely devoid of interest. The chief business was the settlement; and, when that was got through, matters became very quiet indeed. Ascot races proved a powerful counter-attraction, and thus tended to reduce the attendance; while the closing of the Exchange on Saturday further curtailed the hours of business. Beyond this, there seems to be a considerable disposition to remain quiet until after the General Election. In result, prices have, on the whole, not varied much during the week, except in markets which have been influenced by some special circumstances—*e.g.*, American rails. High-class securities, of course, are kept up by the demand for investments; the Money Market continuing in the state of plethora which has characterized it now for so long. The Gas Market was very quiet again—indeed, it could scarcely have been quieter on some days. There have been few changes in quotations, beyond those arising from *ex div.* alterations. But they are for the most part favourable; and they also indicate the continued demand for the secured issues by way of investments. Of the Gaslights, the "A" have varied by a fraction only; being lowered ½ at the start. So little was subsequently done in them as scarcely to afford any indication of a marked tendency; but the closing bargain at 210 was the best of the week. Much more was done in the secured issues, with a buoyant tendency; and all the debenture stocks show a moderate improvement. Very little business was done in South Metropolitans, and prices were only poor; the "B" falling 1½. Nothing at all was marked in Commercials; and quotations were steady. The only alteration among the Suburban and Provincial undertakings is a further advance of 1½ in Brentford new. The Continental Companies have moved somewhat irregularly; Imperial remaining with a flat tendency, while Union and European show an advance in value. None of the rest of the Foreign division have made any particular sign. Water continues to rise steadily; and several stocks show moderate improvements—ranging from 1 to 3 per cent.

The daily operations were: Extreme quietude was the rule on Monday, and but few issues were touched. Brentford new rose 1½. But Imperial Continental receded 1; and Gaslight "A," ½. Prices were better on Tuesday, except for Imperial Continental. South Metropolitan "B" fell 1½. Water was firm. Southwark ordinary and "D" shares and both Lambeth issues rose 2; and New River debenture, 1. Gas remained quiet and unchanged on Wednesday; and the only move in Water was a further rise of 1½ in Southwark "D." Thursday produced no new feature in Gas; and the sole change was a rise of ½ in European part paid. Chelsea Water rose 1. Friday closed a quiet week, without further alteration than an advance of 1 in Gaslight 4 per cent. debenture.

ELECTRIC LIGHTING MEMORANDA.

The Newcastle Electric Lighting Undertaking—The Work of the Electrical Trades Section of the London Chamber of Commerce—An American Electrician on the Electrical Industries of London.

A PAPER on the Newcastle-on-Tyne Electric Supply Company's undertaking was recently read before the Institution of Electrical Engineers; and the authors—Mr. A. W. Heaviside and Mr. R. C. Jackson—naturally did their best to make a good showing for the interesting venture. For us perhaps the most material consideration in regard to electric lighting at Newcastle is the fact that the local gas supply is one of the very cheapest—perhaps actually the cheapest—in the world; and it is therefore interesting to see how an electric lighting company can face the competition of gas sold at 1s. 1cd. per 1000 cubic feet, with 10 per cent. discount. To begin with, the Electric Supply Company recognized the necessity of putting the lowest possible price upon their light; and they accordingly fixed their rate at 4½d. per unit, with 5 per cent. discount. Thus, in addition to having the cheapest gas, Newcastle has the advantage of the cheapest public electric supply in the world. The station was equipped with Brush electric plant and Robey steam-engines; the system of supply being that of the high-pressure alternating current, with transformers of the Elwell-Parker type. The Company can buy their steam coal for 5s. 10d. per ton; and three 200-horse engines represent the generating power. Unlike every other concern of the kind that we ever heard of, the capital account is stated to be closed; so it may be concluded that the Directors are sensible enough to try what their business prospects really are before launching out upon more than the 26,000 lamps of 8-candle power which constitute the actual working capacity of the station. It is stated that the "load factor" of the installation is only 8·16 per cent. The electricity as delivered costs about 2½d. per unit for running expenses; but a good deal seems to be omitted from the calculation of which this figure is the result. The capital outlay upon the station has been low, working out to about 30s. per lamp installed, or £50 per unit. In discussing the paper, Mr. Crompton, of course, endeavoured to show that the Company would have been wiser had they elected to use the low-pressure continuous system; but it was pointed out that, if slightly less working expenses could be claimed for this system, the capital expenditure would have been much higher. The revenue derived from the Newcastle electric lighting seems to be about the average of other places—between 8s. and 9s. per 8-candle lamp per annum, which may be roughly translated, for easy memorizing, into an average of 1s. per candle power per annum.

The London Chamber of Commerce has an Electrical Trade Section; but this organization, from which great things were once expected, seems to be but a dead-and-alive affair. The Section lately held its annual general meeting, when Major Flood Page was elected to the chair, in succession to Mr. R. E. Crompton. Steps are being taken, under the auspices of the Section, to consider what should be done for the representation of the British Electrical Trades at the Chicago Exhibition. The cause of electrical traction is exercising the minds of so many people connected with the electrical trades, that the Section has appointed a Standing Committee to consider and deal with this class of questions, reporting to the Section from time to time. It is understood that, but for this action of the Section, it was within the range of possibility that yet another Association of Electricians would have been formed for the comfort and convenience of such as occupy themselves with matters electrical that do not particularly interest the telegraph and lighting men who constitute the majority in the existing technical societies. One would imagine, however, that electricians of all varieties have already all the accommodation they need for talking to each other, and bringing their prophecies and expectations before the outer world.

An American electrician has been giving his friends at home an account of his impressions of the condition and prospects of the electrical industries of London. He appears to have been struck by many things, and remarks of the inhabitants of London that they "spend so little money for heat, that they can afford to waste some on light; and they pay almost twice as much for an incandescent lamp as we do in New York, in spite of the fact that the price of coal is about the same in both cities." This is one way of looking at the matter; but it does not recommend itself as a very practical or instructive method. The American critic was not without a sense of humour, however; for he remarks that he "visited most of the central stations, and learned from the resident engineer of each that his plant was the most economical of all." This is probably the experience of most of the members of those municipal deputations which have made the same round in the vain effort to ascertain, by inspection and comparison of works in operation, what is the best system for adoption in their own particular case. Again, the gentleman from the States observed that with us "the consulting engineer asserts himself in a way that is unheard of in New York;" and he declared that it "did his heart good to see so many people living on one job." Perhaps this circumstance accounts more satisfactorily than the first hypothesis for the comparative dearness of electric lighting in London. It is some gratification to find that, in American eyes, the electrical industries of England appear to be at least respectably carried on. We may have an Old-World preference for what is good over what is cheap; but this is a drawback, from the point of view of the "hustling" electrician, which cannot be helped.

FRENCH RULES FOR LIGHTING.

(*Concluded from p.* 1115.)

WHEN it is a question of arranging for the lighting of a large hall, architectural and other necessities will determine the height and character of the lustres or centres; and their number will also often be fixed by the same conditions. The illuminating power of these centres or lustres may then be determined with a view to securing a minimum intensity of lighting in the horizontal plane situated at a given height (1 metre, for example) above the floor.

If the positions of the sources of light are imposed by architectural necessities, it often follows that the distribution of the light will not be so uniform as might be desired. (This cannot be helped.) From the practical point of view, the reflecting action of a ceiling can be replaced by the illuminating power of an imaginary luminous source, placed vertically over the actual one, the illuminating power of which is taken to be a certain fraction k of that of the latter. M. Wybauw has made some experiments to determine k in a hall of moderate dimensions; and he has found that we can admit, without much error, $k = 0{\cdot}5$. The introduction of this imaginary light-source into the calculations enables the problem to be treated mathematically; thus giving certain results. But the looseness of the coefficient k prevents the assignment of any great value to the results of calculations of this class. We are therefore driven back upon empirical indications and information deduced from practice.

It is interesting to discuss how the quantity of light may vary according to the geometrical dimensions of an interior without altering the effect. It would appear at first sight that, in order to give the same lighting to two apartments geometrically similar, the quantities of light provided must be in proportion to their surfaces or the squares of the homologous dimensions.

This would be so in the theoretical case of the lighting of spheres from their centres; but it is altogether different in practice. M. Fontaine has ascertained that in most cases the quantity of light should be proportional to the volume of the hall, and not merely to its superficies. For a hall with walls of medium tint, for example, it has been determined that a quantity of light working out to 0·5 candle per cubic metre of the content gives satisfactory lighting when lamps of from 10 to 16 candle power, properly distributed, are employed.

It should be remarked that a hall is never quite empty. It contains furniture and other objects which are so many obstacles to the propagation of light. The supports of the lamps, lustres, candelabra, &c., also intercept a notable amount of light; and, finally, the air itself has not the perfect transparency which the law of radiation supposes. All these detrimentals can be summed up in the statement that the efficient lighting of a source stops short of its full calculated value. The amount of the discrepancy depends upon a variety of practical considerations—the number of obstacles, and the state of the air. It is not the same for a public hall, when the middle space is entirely empty, as for a furnished saloon, for a workshop full of tools, &c.; and it is obviously greatly altered in times of fog.

Taking account of all these qualifying considerations, Dr. Palaz remarks that the data relating to the lighting of interiors of various kinds are very vague. All appears to be reducible to a first assumption of the number of candles per square unit of surface, or cubic unit of capacity, and then to a distribution of the light-sources in such manner as to obtain the most uniform lighting. If, says Dr. Palaz, some specialists in lighting installations are to be followed, it will result that calculations based upon the fundamental laws of photometry will be insufficient to govern installations of all kinds. Cotton and woollen mills, for example, need a great deal of light, especially when coloured or black threads and fabrics are handled therein. According to the experience of M. Uppenborn, if one 10-ampere arc lamp (say, 400 candle power net) will light a space of 2000 square metres out of doors, or 1400 square metres in a railway station, it will only light 500 square metres of a foundry, 200 square metres of a machine-shop, and the same area of a spinning-shed. Dr. Palaz says that a simple way of testing the quality of lighting in a works or factory consists in asking the work-people where they can see best; and he remarks that "the quality and the quantity of the output of a workshop is an indication of quality of the lighting." He adds the remark that the object in artificial lighting is not always the distribution of light with strict uniformity. For manual work or reading, it is often desirable to concentrate the light upon certain points; and in luxurious lighting it is desired to produce a harmonious mixture of light and shade which gives relief to figures, ornaments, &c., even at the expense of the general lighting. Speaking of the common use of reflecting shades for concentrating light downwards, Dr. Palaz protests against the usual constrictions of these at the top, which prevent satisfactory illumination of the ceiling.

This topic of reading-shades leads up to the consideration of the amount of light required for reading. Mr. L. Weber says that the rapidity with which a person can read depends directly upon the degree of lighting. Mr. Cohn declares that nobody ought to attempt to read much or long with less light than that of 10 candles at the distance of 1 metre from the printed page. Dr. Palaz remarks that if anyone wishes to read cursively a certain printed text at a given distance from the eye, there is a minimum of lighting at which this can be done. If the lighting falls below this limit, the reading is no longer cursive—every word has to be separately read; and the general tendency is to draw the page nearer to the eyes in order to increase the apparent angle subtended by the characters. Now, these observations are of a photometrical nature—being based upon the visual acuity; and they are sufficiently precise to afford measurements of lighting. If anyone repeats the experiment with characters of unequal sizes, it will soon appear manifest that, with the same distance from the eye to the page, the lighting must be so much better for cursive reading as the characters diminish in size. A single sheet of paper containing a series of phrases printed in characters of graduated sizes will therefore constitute a true, but simple, photometer of lighting. Mr. Schutte has designed a photometer upon this principle; and so has M. Wybauw. Dr. Palaz concludes his treatise on this subject by briefly discussing the Weber and Mascart photometers for diffused light.

Mr. R. E. Middleton has been appointed as an Assistant-Commissioner to the Royal Commission on the Metropolitan Water Supply.

Death of Mr. A. E. Carter.—We regret to record the death, on the 13th inst., of Mr. Alfred Edwin Carter, Superintendent of the West Middlesex Water-Works Company. For nearly thirty years deceased filled the position of Inspector and Superintendent of the Company's Kensington district; but about ten years ago he was entrusted with the supervision of the whole of the London district. Last month he completed his fortieth year of service with the Company; and as he was intimately acquainted with their entire system of distribution, and always proved himself to be equal to meeting any emergency, his loss will be greatly felt.

TECHNICAL RECORD.

THE PRODUCTION OF OIL GAS FROM RUSSIAN PETROLEUM.

At the Meeting of the London Section of the Society of Chemical Industry yesterday week, at Burlington House, Piccadilly—Mr. Thos. Tyrer, the Chairman, presiding—a paper was read by Professor Vivian B. Lewes, F.I.C., F.C.S., of the Royal Naval College, Greenwich, on the above subject.

The author commenced with a reference to a paper read before the Society by Professor H. E. Armstrong, in 1884, on the manufacture of gas from oil. In that paper, the writer gave the result of his analyses of the liquid deposited from oil gas under pressure, which showed it to be rich in such benzenoid hydrocarbons as benzene and toluene, mixed with the hydrocarbons of the $C_n H_{2n}$ and $C_n H_{2n-2}$ series. This, Professor Lewes remarked, was of great interest, as it showed that the vapours of these compounds were present in the uncompressed oil gas. But as the deposition of nearly a gallon of these liquid hydrocarbons from 1000 cubic feet of the gas only reduced its illuminating value from between 50 and 60 candle power to 40 candle power, it was evidently important to gain an insight into the nature of the hydrocarbons present not only in the gas, but also in the tarry residue which distilled over during decomposition; whilst to trace the decompositions taking place, it was necessary to examine the products formed at lower temperatures than those usually employed in oil-gas manufacture.

Professor Lewes here described the apparatus he employed to carry out the destructive distillation of the oil for the earlier of the experiments recorded in the paper. He used an iron retort 10 inches long and 4 inches in diameter, the mouth of which was closed by a flat iron disc. The oil-supply pipe was led through the front disc to within ½ inch of the back of the retort; and the gas passed away by a pipe running upwards from near the mouth of the retort to the vessel in which the residue was condensed. In order to observe the temperature of the side and interior of the retort, the furnace and the disc were provided with sight holes; and the retort was packed with coarse iron turnings to give as large a heating surface as possible. The gases were led into small 10 cubic feet gasholders, and were analyzed directly they were cold; and also after standing. [A description of the method of analysis employed will be found at the bottom of the second column of p. 692 of the Journal for April 14 last year.] Having briefly referred to this method, the author remarked that, in the tables exhibited in the room, the hydrocarbons were given as saturated and unsaturated; his experience being that at present it was absolutely impossible to attempt any subdivision of these bodies, and that, in cases where it had been attempted, the results were most misleading. An Evans photometer was used to determine the illuminating value of the gases; the burner, pressure, and rate of flow being carefully regulated to suit the quality of the gas, and give the most perfect flame—the results being then calculated to a consumption of 5 cubic feet. With this exception, the testings and corrections were all made according to the "Instructions" of the Gas Referees. The temperatures employed were judged on the basis of Pouillet's experiments, as the form of apparatus used did not lend itself to direct pyrometric determinations.

The author then referred to the figures contained in the table on the next page.

Commenting upon the experiments made in the small retort (the results of which are shown in columns A, B, C, and D), Professor Lewes said that, starting with a temperature of 500° C., and running the oil in at a definite rate of flow, only 12 cubic feet of gas were obtained, and a large percentage of residuals. But the latter did not represent the whole of the residuals, as a considerable proportion of hydrocarbons, which were present almost entirely as vapours, went forward with the gas, and condensed in the gasholder. After their condensation, the gas only amounted to 12 cubic feet, and contained the unsaturated and saturated hydrocarbons in almost equal proportions. The low temperature was an important point. In the second column, he gave the results of decomposing the oil at 700° C.; in the third, at 900° C.; and in the fourth, at 1000° C. Here they could trace the effect of the increase of temperature not only upon the yield of gas, but upon the proportions of the unsaturated and saturated hydrocarbons. At 900° C., it would be seen that there was not only an increase in the volume of the gas, but in the illuminating power; while the unsaturated hydrocarbons were the same as in the previous column, but the saturated hydrocarbons showed a large increase. At the same time that they had these changes in the gas, they also found considerable changes taking place in the residues. In the second column, the residuals were shown to have decreased from 59·1 to 22·7 per cent. of the original oil decomposed; and 36·5 per cent. distilled below 200° C., 9 per cent. at 123° to 125° C., and 9·5 per cent. at 140° C. to 150° C. Of the 12·7 per cent. of residuals in the third column, not more than 1 per cent. distilled at 100° C., and 5 per cent. at a little over 110° C. At 1000° C. (column D), there was another increase in the volume of the gas; but the illuminating power fell to 42 candles. The percentage of saturated hydrocarbons slightly increased; while the hydrogen rose to 21·54 per cent.

The Decomposition of Russian Distillate Oil.

Specific gravity = ·864. Flash point, 149° Fahr. = 65° C.

	A	B	C	D	E	F
Temperature of retort	500° C.	700° C.	900° C.	1000° C.	900° C.	900° C.
Size of retort	1 ft. 10×4 in.	1 ft. 10×4 in.	1 ft. 10×4 in.	1 ft. 10×4 in.	4 ft. 6×2 in.	3½ ft.×9½ in.
Cubic feet of gas per gallon	12	60	72	84	92	98
Percentage of residuals	59·1	22·7	12·7	11·8	18·3	20·2
Illuminating Power in—						
Candle power per 5 cubic feet	54·8	50·7	57·1	42·2	46·0	49·6
„ „ gallon of oil	131·5	608·4	822·2	708·9	846·4	972·1
In grains of sperm do.	15,782·4	73,008	98,668·8	85,075·2	101,568	116,659·2
Analysis of gas percentages—						
Unsaturated hydrocarbons	39·13	36·56	36·55	22·04	29·79	33·16
Saturated hydrocarbons	42·41	49·45	53·97	54·83	62·30	45·15
Hydrogen	13·58	6·26	11·86	21·54	4·79	19·65
Acetylene	0·052	0·084	0·38	0·46	—	—

On the other hand, the unsaturated hydrocarbons fell to 22·04 per cent. The colour of the gas had become "sooty," from separation of the carbon; and this, as well as the increase in hydrogen, showed that the temperature had been forced to a point at which some of the hydrocarbons were entirely broken up, and that it had been the unsaturated hydrocarbons which had been destroyed. The residuals collected from the gas made at this temperature were of nearly the same volume as those obtained by decomposing the oil at 900°; but they differed from it in containing nothing with a lower boiling point than 140° to 150° C. It would be observed that the best results in columns A to D were those obtained in C—72 cubic feet of 57·1-candle gas; but as anyone who has worked with oil gas on a continuous scale with large retorts would only too well know, this was a poor result.

After these preliminary experiments, the next thing the author did was to try larger retorts, to see how far the surface in the retort affected the changes taking place. For one experiment he used an iron retort 4 ft. 6 in. in length and 2 in. diameter, closed at one end, and with an oil-tube passing down the centre, and terminating about an inch from the closed end, while the gas was led away from the other. For the second experiment, a Patterson oil-retort, 3 ft. 6 in. by 9½ in., was employed, with two oil-tubes passing to the back. A temperature of 900° C. was used in each case. In this way, it was possible to find the conditions under which the oil could be decomposed to the best advantage, as the experiments already described gave the cracking of the hydrocarbons with a very little heating of the gases after their formation; whilst the long (2 inch diameter) tube retort gave an excess of heating by contact with the red-hot side of the tube, and with the large round retort, on account of its capacity, the effect of less contact with the sides, but a longer baking in mass of the oil gases and vapours, could be traced. (The results obtained are given in the columns E and F in the table.) The author pointed out that here they had a large increase in the volume of gas, and in the illuminating power per gallon of oil used. Taking the Patterson retort, they had 972·1 candle power per gallon of oil; while with the short retort, the best result obtainable was 822·2 candles.

Continuing, Professor Lewes said that Russian petroleum was widely different from the Pennsylvania product, and had been shown to consist largely of hydrocarbons of the $C_n H_{2n}$ group —*pseudo*-olefines or naphthenes; and, with the exception of $C_{13} H_{26}$, a complete series from $C_8 H_{16}$ to $C_{16} H_{30}$ had been separated from it. When this oil was first cracked by contact with heated surfaces, it decomposed, yielding both saturated and unsaturated hydrocarbons, the latter containing homologues of acetylene. Some of these hydrocarbons were gaseous, whilst the remainder varied in their boiling-point from 60° C. to very high temperatures. From experiments he had made, he found that, on heating ethylene by passing it through a heated narrow tube, nothing happened until a temperature of 800° C. was reached, and then at between 800° C. and 900° C. it broke up into acetylene and methane; and if the heat was kept well up to this, the acetylene polymerized to benzene, which could be condensed from the gas and identified. If the heat were continued and raised to about 1000° C., further polymerization would take place, with the formation of still higher bodies, among which crystals of naphthalene were conspicuous; whilst, at 1100° C., these again broke down to acetylene, which then decomposed into carbon and hydrogen. Menthane, when heated at 900° C., practically underwent no change; but ethane at this temperature gave up hydrogen, and became ethylene, which again decomposed into acetylene and methane. From his experience, the author had little doubt that the formation of benzene from Russian petroleum was due not to one action but to several. In the first place, all experimental evidence clearly showed that benzene was formed from acetylene by polymerization, and that this took place at temperatures existing in the oil-gas retort. But it was not conceivable that this addition could do more than contribute its share to the 20 per cent. of benzene to be found in the oil-gas tar from the Russian oil. Then, again, when the original oil was decomposed, large quantities of the higher paraffins were formed; and these, by elimination of hydrogen, yielded benzene. And, finally, the higher *pseudo*-olefines, of which the Russian oil itself consisted, probably partly broke down directly to benzene and paraffin in the same way that the simplest member of the group ($C_2 H_4$) yielded acetylene and marsh gas. The ease with which benzene could be obtained from Russian petroleum, he added, was shown by the fact that, not far from Novgorod, it was manufactured on a very large scale by Messrs. Ragosin and Co., who obtained, according to Dr. Dvorkovitch, 400 kilos. of 50 per cent. of benzene and 30 per cent. of anthracene from 1000 kilos. of oil.*

In decomposing oil in retorts, the paper proceeded, two distinct periods of decomposition took place—(1) The breaking up of the oils under the influence of heat; and (2) the changes taking place in the first-formed products during their passage up the heated retort. An examination of the constituents of the gases formed during decomposition at a low heat in the short retort—conditions which practically eliminated the secondary action—gave a valuable indication of what was taking place. They found that, in the gas made at 500°C., the saturated and unsaturated hydrocarbons were in nearly equal proportions, but that, as the temperature rose, the unsaturated hydrocarbons gradually decreased in quantity, while the saturated hydrocarbons increased, as, although the higher paraffins were broken down by the heat, they formed methane, which was but little acted upon, and also hydrogen; and it was this breaking down of the richer hydrocarbons into a larger volume of simpler ones which gave the great increase in volume found at high temperatures and the consequent loss in illuminating value.

In examining the residuals obtained by "cracking" the oil in the Patterson retort, the author found that the original tar had a specific gravity of ·944; and, on fractionally distilling it, there were found certain temperatures at which a far higher proportion came over than at others. He here exhibited a diagram, which strongly suggested that the large proportion of paraffins present in the portion distilling between 60° and 150° C. consisted of normal hexane and hexylene, which boiled at 68° to 71·5°, heptane and heptylene, which boiled at 90° C., and nonane, which boiled at from 136° to 138° C., while benzene was responsible for the large distillate at 80° C.

To determine the proportion of saturated and unsaturated hydrocarbons present, the distillates below 100° C. were mixed together, treated in a manner described by the author, and distilled; the result being: Olefines, 70 per cent.: benzene, 19 per cent.; and paraffins, 11 per cent. The fractions distilling between 100° and 150° C., had a specific gravity of ·809, and gave: Unsaturated hydrocarbons 19 per cent. and saturated hydrocarbons, 81 per cent.; from 150° to 260° C., a specific gravity equal to ·956, and gave unsaturated hydrocarbons 20 per cent., and saturated hydrocarbons, 80 per cent.; from 260° to 315° C., a specific gravity equal to 1·002, and gave unsaturated hydrocarbons 12 per cent., and saturated hydrocarbons, 88 per cent. This, Professor Lewes said, showed that the higher the distilling point and specific gravity of the fraction, the greater was the percentage of saturated hydrocarbons; while in the most volatile portion of the residue, the unsaturated hydrocarbons preponderated. During the fractional distillation of the tar, large quantities of naphthalene volatilized and condensed in the neck of the retort.

In concluding the paper, Professor Lewes remarked that in all experiments upon the decomposition of Russian petroleum, and in making oil gas from it on a large scale, great trouble was found from the ready deposition of carbon and pitch, which seemed to form from it more readily than from shale and American oils; and he imagined that it was upon this that the formation of so large a proportion of saturated hydrocarbons in the residuals depended. When cracking the Russian oil by itself, the best results obtained were 98 cubic feet of 48·5-candle power gas, equal to 972.1 candles per gallon of oil; and this agreed very well with the best results obtained in working in this way on a big scale. But when the Russian distillate oil was decomposed in the presence of an inert gas, and was then exposed to a high temperature for some time, a considerable increase in the total amount of illuminating power obtainable from the oil was observed. At the Beckton Gas-Works this oil was used on a large scale for making carburetted water gas, according to the improved Lowe system; and the illuminating power obtained and the volume of gas formed was considerably higher —1200 candles per gallon of oil being obtained instead of 972 candles. This was an increase of more than 23 per cent., and was due partly to the diluting influence of the water gas, which prevented the decomposition going too far, and also to the breaking up of the benzene, which otherwise would have found its way into the residuals. An analysis of the tar obtained from the carburetted water-gas plant at Beckton, and which was given in

* See *ante*, p. 960.

a paper read by Messrs. Paddon and Goulden at the May meeting of the Incorporated Institution of Gas Engineers, showed that it contained above 76 per cent. of water, and on removing this only 1·19 per cent. of benzene was found in the concentrated residue.*

In the course of the discussion which followed,

The CHAIRMAN said that several important communications had been read before the Society on the subject of petroleum, and the present one was by no means the least important of them. He would remind the members (as they had already been reminded by Professor Lewes) of a paper which, at the time it was read, was predicted to become historic—he referred to the paper by Dr. Armstrong. If he might say so, without any disrespect to a scientific man, he thought it would have been well if the promise which was then made had been carried out by a continuation of those researches. He believed it was admitted, if his memory served him right, that Dr. Armstrong's paper had in it the germ of a revolution as to the views held by scientific and practical men with regard to the decomposition that took place when liquid hydrocarbons were submitted to high temperatures under given conditions. It was to be regretted that the work then began was not continued; and his object in making these remarks was to urge once more upon the members not to drop, for their own sakes, a good thing when they had one in hand. There were many luring topics for criticism, investigation, and research; but research was nothing if it was not painstaking and continuous.

Mr. T. FAIRLEY, of Leeds, remarked that he had been very interested in Professor Lewes's experiments. He had not himself had any practical experience with oil gas; but he had had a good deal to do with ordinary coal gas work. He should like to ask the author of the paper if his notes supplied any information with regard to the rate of flow of the oil into the retorts, coupled with the amount of heating surface and the temperatures.

Mr. WATSON SMITH said he should like to ask Professor Lewes, if it would prove that benzene did, on high heating, pass into naphthalene. Benzene, when strongly heated alone, did polymerize and form diphenol; and this was its chief tendency. It was possible, however, that benzene, together with some lower unsaturated hydrocarbon, might yield naphthalene; but he could hardly conceive benzene polymerizing and forming naphthalene. Possibly diphenol derivatives were obtained. Was that the case?

Mr. BOVERTON REDWOOD said the paper before the meeting appeared to demand more consideration than he for one had been capable of giving it during the time which had been occupied in its delivery; but there were nevertheless a few general remarks which perhaps he might be permitted to make, without having fully digested all that the author had said. As to the practical importance of this subject, there could not be two opinions. Anyone who had taken the trouble to consider what had been done in the United States in the substitution of carburetted water gas for coal gas, would see that the time was approaching, and was within measurable distance, when to a large extent carburetted water gas or carburetted hydrogen would be introduced into general use in this country. The difficulty of obtaining cannel coal for carburetting was an increasing one, and the labour trouble was naturally favourable to such a change. They had only to consider that, in New York and other important cities in the States, the illuminating gas supplied was almost entirely carburetted water gas, to see that it was at any rate quite feasible to make the change he had indicated. Of course, circumstances here were somewhat different in regard to the supplies of material which it was proposed to use as a substitute; and he might be pardoned perhaps, as one who had taken some special interest in the subject of petroleum, for looking upon this change as a probable one upon a somewhat slender basis of fact. But the subject demanded, and was deserving of, the fullest consideration; and he therefore thought they should feel greatly indebted to Professor Lewes for having undertaken the investigation of this question. There was no doubt that a great deal of the work which had been done in this country, although experimental and practical, had been carried out unsystematically and unscientifically, and (he believed he might say) unintelligently. He did not apply this remark to the whole of the work that had been done; but a great deal of it had been wasted, from the fact that there had been no intelligent system adopted. He had had a good deal of experience in the manufacture of oil gas; and he believed he knew something of what the difficulties were that had to be contended with in carrying out such an investigation as Professor Lewes had undertaken. The results depended upon certain factors, and these factors were of a certain character under the particular conditions of the experiment; and it was difficult to work out from the results obtained under certain conditions the results one would get under different conditions. As to the view Professor Lewes had put forward with regard to the conversion of acetylene into benzene and other hydrocarbons, it was a convenient and pretty theory; and there was no doubt much to be said in favour of it. When in St. Petersburg, he had the privilege of witnessing experiments carried out by Messrs. Nobel, who were at that time effecting the conversion of the Russian residues on a large scale; and they obtained extremely satisfactory results. The particular hydrocarbons composing Russian oil did lend themselves to that change with great facility; and he thought there could be no doubt whatever that the oils were therefore very suitable for use in the manufacture of oil gas. On the other hand, he was not at all clear—having in view his experience of many years ago in the manufacture of oil gas, and more recent experience in the conversion of the heavy hydrocarbons into lighter hydrocarbons—that it was wise to attempt the direct conversion of the heavy Russian oils into gas. He could not speak with confidence, as he had not carried the matter out experimentally to a large extent. As far as Professor Dewar's and his own experience had gone—he must not be taken to commit Professor Dewar to anything in his absence—their results led him to the conclusion that it might be desirable, in the utilization of these heavy hydrocarbons (which had a comparatively small commercial value), to effect their preliminary conversion into other hydrocarbons; and these might be more readily converted into gas—in point of fact, they were more manageable. One might more easily control the cracking of the liquid hydrocarbons into other liquid hydrocarbons of a lower specific gravity and greater volatility, and then the conversion of these into gas, than one could the conversion of the heavier hydrocarbons direct into gas. He hoped Professor Lewes would not overlook this point; and he believed he would find it a fruitful subject for investigation. His paper was a thoroughly practical and valuable contribution to their knowledge of the subject.

Professor W. FOSTER, having remarked that it was beginning to dawn on those interested in this question that a large amount of work had been done in this direction without any system or science, referred to the work of Drs. Edward and Percy Frankland, for which, he said, he had the greatest regard. Some of Frankland's work had never, in his opinion, been appreciated at its true worth. A few years ago, Dr. Percy Frankland showed the relationship between the paraffins. He tried marsh gas, and then took ethane and propane gas; and he believed he stopped there. The curious point was the olefines of the $C_2 H_4$ series gave him 70 candles per 5 cubic feet. The CH_4 he believed he put at 5. The $C_2 H_6$ had a light of about 35 candles. He forgot what the $C_3 H_8$ had, but it was practically 53 candles. His (Mr. Foster's) point was this, that last year he had the opportunity of getting $C_4 H_8$; and the lighting value was almost double that of ethylene. The extraordinary thing about it was that ethylene had a lighting value practically double that of ethane. With the olefines they could get just double the lighting value for the same volume.

Mr. MORRISON inquired whether Professor Lewes had tried any experiments with regard to the permanency of the gas.

Mr. W. J. BUTTERFIELD asked if it was possible at a certain temperature to form acetylene from naphthalene. If this was so, he should be glad if Professor Lewes would kindly tell them the temperature, as naphthalene was a residual product in gas-works, and it would be quite easy to make a valuable thing of it if they knew the exact temperature at which acetylene could be formed. He was not quite clear on this point either. He understood that 20 per cent. of benzene could be found in the residues in certain instances; and he should like to know the conditions under which this obtained. Of course, he presumed that Professor Lewes meant benzene and not hydrocarbons of the benzene series. Again, as to the amount of benzene in the residuals of carburetted water gas, Professor Lewes quoted from a paper by Messrs. Paddon and Goulden, who gave a little over 1 per cent. of benzene. Was this in the residual dehydrated, and were there any paraffins accompanying it of about the same body or boiling point, or not? So far as he (Mr. Butterfield) had seen, from residuals from carburetted water gas, they had from 4 to 5 per cent. of benzene; but unfortunately it was considerably contaminated by paraffins of much the same boiling point. It would also be interesting to know if there was any large proportion of anthracene in the residuals from either pure oil gas or carburetted water gas. If 20 per cent. of benzene was obtained, or any amount of anthracene, it would be almost worth while making the gas as a residual. (Laughter.) He should further like to know whether the yield of gas, or say the value in candles per gallon of oil, was not larger from heavier Russian oil than the author of the paper had experimented with. Certain Russian oils would give (roughly speaking) 1000 to 1200 candles with admixture with water gas; and he should like to know if Professor Lewes had tried any heavier oils.

Professor LEWES, in reply, said that Mr. Fairley asked if he could give him any data as to the rate of flow of the oil into the retorts. It was manifest that, in the variations in the sizes of retorts employed, it would have been impossible to have used a constant rate of flow. In A, B, C, and D, the experiments were made with the same sized retort, and everything was done that could make them as nearly uniform as possible; and in these experiments he was working with a rate of flow of 2 pints per hour. It should be remembered that this was only a small retort. With the large Patterson retort, on the other hand, they were working with a flow of about 1¼ gallons per hour; and the way in which the three experiments at 900° were made comparable was by noticing the colour of the gas. When they were making gas at 500° C., the gas came off as a dead white vapour. When they reached 700° C., the gas was of a yellowish buff colour; and

* See *ante*, p. 908.

this meant that they were doing much better work. At 900° C.—the best temperature for cracking the oil—the gas was of a rich chocolate brown. In the three experiments, they simply worked to the colour of the gas; and the flow of oil was so regulated that they kept the gas at a rich chocolate brown. Mr. Watson Smith asked some questions as to the polymerization of acetylene into benzene, and then the formation of naphthalene afterwards. His experiments had gone so far as this: He had been working with narrow tubes, and taking the temperature of the gas as it passed through the tubes under conditions mentioned in the paper, he found that acetylene was formed when he reached a temperature of 800° and upwards. At 900° and close upon 1000°, if he placed a small cool receiving vessel at the end of the tube, he obtained a liquid which had the smell of benzene, which could be identified by the aniline test. Then, as the temperature rose, he got a smaller quantity of far heavier substance, and crystals of naphthalene began to appear; and carrying the heat of the tube to a still higher temperature, he did not get these, but simply carbon and hydrogen. This showed that, working at a temperature of from 800° to 900°, these various changes took place, and the building up of these various compounds resulted; but with a temperature (say) of 1250°, the higher compounds were not formed. Mr. Morrison asked a question as to the permanency of the gas. Properly made oil gas was far more permanent than coal gas. If they took a ½-inch compo. pipe, 120 feet long, made it into a small coil, and put it into a bucket of water at freezing-point, and passed coal gas through it of 16-candle power and upwards, they would not afterwards be able to read the illuminating power; but if they took a well-made oil gas of (say) 45-candle power, and passed it through the coil at freezing-point, it would be found that not more than 3 candles had been taken out of it. Oil gas made at low temperatures would not do this. The question as to the 20 per cent. of benzene he thought arose from, he was going to say, a misconception; but what he intended to infer, and what he said was, that 20 per cent. of the hydrocarbons distilling below 100° C. consisted of benzene, but 20 per cent. of benzene was absolutely obtained from the Russian oil. The figures he quoted were 40 per cent. and 50 per cent. benzene; and they also had 30 per cent. of anthracene formed. One gentleman said that, if this was the case, it would be worth while to make the residuals as the chief thing, and to use the gas as a bye-product, and this elicited a laugh. In two or three years time, they would find that this was what would be done. They could make a tar which would be of the greatest possible value with the Russian oil; and they would get an enriching gas from that at a very low rate indeed. He was also asked whether it was not a fact that, by using heavier oil, a higher illuminating value could be obtained. That was perfectly correct. If they used the crudest Russian oil obtainable, they would get, as one gentleman suggested, 1000 candles (he would not go so far as 1200 candles); and, moreover, they would obtain such a deposit of pitch, that they would not be able to work more than a few hours at a time.

A hearty vote of thanks was then passed to Professor Lewes for his paper.

Contemplated Purchase of the Runcorn Water-Works by the Local Authority.—The members of the Finance Committee of the Runcorn Improvement Commissioners have waited upon the Directors of the local water-works for the purpose of making preliminary inquiries with regard to the works being transferred to the local authority. The deputation having stated the object of their interview, the Directors promised to carefully consider the subject, and furnish, as soon as possible, the desired information.

The Rathmines Water Commissioners and their Reservoirs.—A special meeting of the Rathmines Commissioners was held on Monday of last week to consider the position in which they stood as to the decision of the House of Lords in the matter of the construction of reservoirs on the Dodder. It was agreed, after a full discussion, to engage the services of an eminent engineer, if found necessary after conference with the mill-owners, to report fully on the present state of the water-works, having regard to the judgment against the Board.

Sales of Shares.—Among a number of shares in various companies sold at Portsea a few days ago, were two £5 (1861 issue) 10 per cent. shares in the *Portsmouth Water Company*, which realized £13 7s. 6d. each; also one "C" £50 fully-paid share in the *Portsea Island Gaslight Company*, which produced £98, and two others, which fetched £99 per share.—At Dundee last Friday, an annuity of £45 11s. of the *Dundee Gas Commissioners* was put up at £289, and was purchased by the Commissioners at £300 5s. per £10 annuity—£1362 in all—or about 30 years' purchase; and a £3 annuity of the *Broughty Ferry Gas Commissioners* was submitted at £89, and was sold at £90 5s.

The Water Supply of Pudsey, Farsley, and Calverley.—The Joint Committee of the Pudsey, Farsley, and Calverley Local Boards have decided to apply to the Bradford Corporation to be supplied with water in the three districts on the terms that the Liversedge Local Board had obtained by their opposition to the Corporation Bill—viz., that they should be supplied with water on the same terms as it was supplied within the borough, or at the price of 6½d. per 1000 gallons when delivered in bulk, and to begin at 1s. 6d. for small consumers where the present scale commenced at 3s. 6d. per quarter. If the Corporation refuse to place them on these terms, the Committee state that they will be justified in asking if they decline the responsibility of supplying water; and if they receive an affirmative answer, they understand that they will then be in a position to buy water in the open market. If the Corporation agree to supply on the Liversedge terms, the plant just acquired by the Joint Boards will have to be sold at a valuation.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by correspondents.*]

A Question for the President of The Gas Institute.

SIR,—Mr. Valon, in his most interesting Inaugural Address to The Gas Institute, made the following statement: "It is well known that, if every trace of free ammonia is removed before passing the gas through lime, the action of the lime will liberate the fixed ammonia and although no free ammonia is at the inlet, free ammonia will appear at the outlet in larger quantities than is sometimes desirable."

I should be glad to learn if Mr. Valon has proved the presence of "fixed" ammonium compounds in the gas at the inlet to the purifiers at a time when no free ammonia was indicated.

It is well known that gas free from ammonia at the inlet of a lime purifier frequently shows traces of that impurity at the outlet; but it is, I think, generally believed, on the authority of Professor W. Foster (*vide* JOURNAL, Vol. XL., p. 1124), that the ammonia so liberated is supplied by the decomposition of calcium cyanate.

Birmingham, June 16, 1892. E. LLEWELLYN PRYCE.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills read the first time: Bexhill Water and Gas Bill; Newcastle-upon-Tyne Improvement Bill.

Bills read a second time and committed: Birmingham Corporation Water Bill; Exmouth and District Water Bill; London Water Bill.

Bill referred to a Select Committee, consisting of Lord Northington (Chairman), the Marquis of Bristol, Earl Lindsay, Earl Radnor, and Lord Tollemache; to meet on Wednesday, June 15: Birmingham Corporation Water Bill.

Bills referred to a Select Committee, consisting of Lord Brougham and Vaux (Chairman), Earl Abingdon, Lord Zouch of Haryngworth, Lord Fingall, and Lord De Saumarez; to meet on Wednesday, June 15: Electric Lighting Orders Confirmation Bill (No. 5); Lanarkshire (Middle Ward District) Water Bill; Water Orders Confirmation Bill.

Bills reported: Bournemouth Improvement Bill; Electric Lighting Orders Confirmation Bill (No. 5); Lanarkshire (Middle Ward District) Water Bill; London Water Bill; Rhyl Improvement Bill; Water Orders Confirmation Bill.

Bills read the third time and passed: Airdrie and Coatbridge Water Bill; Brynmawr and Abertillery Gas and Water Bill; Electric Lighting Orders Confirmation Bill (No. 5); Gas Provisional Orders Bill; Stamford and St. Martin's Stamford Baron Gas Bill; Rhyl Improvement Bill; Water Orders Confirmation Bill.

Petitions against the following Bills have been presented:—

Birmingham Corporation Water Bill, from the Corporations of Aberavon, Hereford, and Neath; the County Councils of London, Glamorgan, and Monmouthshire; the Local Authorities of Barry and Cadoxton, Briton Ferry, Bridgend, Cardiff, Maesteg, Margam, Merthyr Tydfil, Ogmore and Garw, Penarth, Pontypridd, Swansea, and Ystradyfodwg; and several private persons whose interests are affected.

Water Orders Confirmation Bill [Sevenoaks Water Order], from Owners of property and ratepayers in the district of the Sevenoaks Local Board.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Bills read the first time: Electric Lighting Orders Confirmation Bills (Nos. 4, 5, and 6); Water Orders Confirmation Bill.

Bills read a second time and committed: Bexhill Water and Gas Bill; Gas Orders Confirmation Bill.

Bills reported: Bexhill Water and Gas Bill; Gas Orders Confirmation Bill; Ilkley Local Board Bill; Newport Corporation Bill; Rhymney Valley Gas and Water Bill; Western Valleys (Mon.) Water (Gas Purchase) Bill.

Bills read the third time and passed: Ashton-under-Lyne Water Bill; Bexhill Water and Gas Bill; Bradford Corporation Water Bill; Glasgow Corporation Water Bill; Newcastle-upon-Tyne Improvement Bill; Newport Corporation Bill; Pontypridd Water Bill; Rhymney Valley Gas and Water Bill; Swansea Corporation Water Bill; Western Valleys (Mon.) Water (Gas Purchase) Bill.

Bexhill Water and Gas Bill.—This Bill, which was introduced into Parliament late in the session, and has passed through all its stages in the Lower House, authorizes the Bexhill Water and Gas Company to raise additional share and loan capital for the purposes of their undertaking. It was proved to the Committee who considered the Bill that the undertaking was in course of development, that the Company had not paid any dividend on their existing share capital, and that if provision were made in the Bill for the offer of the additional capital proposed to be raised by public auction, there was no likelihood whatever of its being issued at a price equal to par. Under these circumstances, the Committee were of opinion that the provisions of the Standing Orders ought not to be required in the case of the additional capital authorized by the Bill. They further reported that they had amended the preamble by inserting a recital that the Company had not paid any dividend on any portion of their capital.

MISCELLANEOUS NEWS.

EDINBURGH AND LEITH GAS SUPPLY.

The Financial Position of the Undertaking.

The accounts of the Edinburgh and Leith Gas Commission for the year from May 16, 1891, to May 15, 1892, were issued last Friday. They show that the stock capital remains at £350,000, and that the loan capital is £134,698—an increase of £30,000 during the year. The Commissioners have still borrowing powers to the amount of £165,301. The capital expenditure during the year was as follows: Works and manufacturing plant, £1306; main and service pipes, £13,050; meters, £812; and gas cooking and heating stoves, £235. The total expenditure upon capital account was £15,419. After raising £30,000 upon mortgage, there still remains a debit balance of £6722 upon the capital account, which now amounts to £491,421. In the revenue account, coal (135,219 tons) cost £125,267; purifying materials, oil, water, and sundries, £6799; salaries of engineers, &c., and wages and charges at works, £35,571; repairs and maintenance of works and plant, £7791; distribution charges, £20,326; management, £6420; feu duties, rates, and taxes, £8231; law and parliamentary expenses, £336; pensions and allowances to old employees, £1474; discounts, rebatements, and bad debts, £6205—making a total of £218,423. The revenue consisted of: Gas (1,221,513,700 cubic feet), £270,918; coke, £5996; tar and ammoniacal liquor, £15,603; waste lime, £53; rents of properties not in the occupation of the Commissioners, £317; and transfer fees, £23—making a total of £292,912; and leaving a balance of £74,489. In the profit and loss account, the revenue was, with a balance of £14,569 from the previous year, and £74,488 from last year, £89,058. On the expenditure side, annuities required £34,000; interest on debentures, £3836; interest on bank overdrafts, £885; other interests, £205; and expenses of mortgages, £168—making a total of £39,096, and leaving a net balance of £49,962. The sinking fund for the repayment of borrowed money amounted on the 15th of May, 1892, to £3304; and for redemption of annuities, to £23,012. To the former there falls to be added, in terms of the Commissioners' Act, £1197; and to the latter, £7267—together £8464; raising the former to £4501 and the latter to £30,270. The reserve fund, which prior to the above-named date amounted to £28,604, is now only £2703; the money having been employed to defray the cost of renewals in the Edinburgh works. The general balance-sheet shows a debit of £91,587, made up as follows: Balance at debit of capital account, £6722; annuities account, £16,828; unclaimed dividends, £78; deposit receipt accounts, £1966; debenture interest account, £2081; North British Railway stock (held in security), £1000; house-rents outstanding at Whitsunday, 1892, £119; trade accounts (tar and ammoniacal liquor), £1516; gas consumers' accounts outstanding, £39,651; gas-stove accounts outstanding, £90; and coal, lime, and other stores on hand on the 15th of May, £21,533. On the credit side, the items are: Current bank accounts, £909; deposits from consumers, £5384; payable for coal, £7859; other accounts due by Commissioners, £250; dividends of gas companies unclaimed, £78; deposits from contractors (held in security), £4966; debenture interest unpaid, £2081; annuities unpaid, £16,828; wages due to workmen on the 15th of May, £456; feu duties payable at that date, £107; reserve fund, £2703; and balance at the profit and loss account, £49,962.

DUNDEE GAS COMMISSION.

Increase in the Price of Gas.

The Annual Meeting of the Dundee Gas Commission was held on Wednesday last—Lord Provost MATTHEWSON presiding.

Mr. J. MITCHELL, Convener of the Finance Committee, in presenting the annual report, expressed his regret that the result should be somewhat disappointing, and that the estimate framed a year ago should not have been realized. This result, notwithstanding an increased sale of gas, had arisen largely from the fact that the yield per ton of coal carbonized fell short of the estimated quantity by 162 cubic feet per ton, as also from the unprecedentedly low prices ruling during the year for secondary products. In place of getting, as they reckoned, 10,000 cubic feet per ton, they only had 9838 feet, or a short extract on the quantity of coals carbonized of 8,324,694 feet, representing a sum of fully £1500. This and other things caused the debit balance of £2381 with which the year was commenced (and which the Committee expected to wipe out) to be increased at the close to £4780. Acting on previous experience, at the beginning of last year, they reckoned on an increased consumption of gas; but they were not prepared for anything like the rise which had taken place. They reckoned that 490 million cubic feet would meet the requirements, and that for this 49,000 tons of coal would be needed. This was contracted for at an average price, with firemen's wages, &c., of 20s. 8d. per ton. In place of 490 million cubic feet being produced, the quantity was 504,778,600 cubic feet, or 14,778,600 cubic feet over the estimate, and fully 34,000,000 cubic feet beyond the quantity produced in the previous year. Of this there had been sold 448,245,950 cubic feet, 5,633,100 cubic feet were consumed at the works, and 50,899,550 cubic feet were unaccounted for, or about 10 per cent. of the total make. This increased output of gas naturally caused a corresponding increase in the coal and other accounts. Instead of 49,000 tons, they carbonized 51,387 tons; costing, on an average, 20s. 10½d., or a sum of £53,644. For purifying, in place of £920 as estimated, they had to spend the sum of £1513, or £593 over the estimate. The total expenditure, including the debit balance with which the year was commenced, was £94,732, or an increase of £3853 beyond the estimate. The additional consumption of gas naturally gave them an augmented revenue; gas sold and meter-rents producing £81,439, as against £79,596 estimated, or an increase of £1843. But against this there was a marked decreased revenue from coke and residual products, the former yielding £1227 instead of £3000, and he latter £6906 instead of £8166; or in all a deficiency from these two urces of £3031. The result of the year's working was a debit balance of £4780, which had to be met out of the year's revenue. It had not been considered advisable to reckon upon any increase in the demand for gas over last year. This, he thought, was wise, more especially in view of the probable early introduction of the electric light, as well as from the depressed condition of the general trade of the city. They had reckoned upon requiring 50,500 tons of coal, which, at 10,000 cubic feet per ton, should yield 505,000,000 cubic feet of gas. The average price of the coal already purchased did not exceed 16s. per ton; and they were hopeful that they would be able to purchase what might be needed for the remainder of the year at this, if not at a somewhat less price. With firemen's wages, breaking, &c., the price would not exceed 19s. 8d., or 1s. 2½d. per ton below the actual cost of last year. He concluded by moving that the price of gas be fixed at 1d. per 1000 cubic feet higher than last year, and that the residual products should be sold to the best advantage and at the market price of the day, but subject to all existing contracts now to be entered into. He took the opportunity of testifying to the zeal and attention of the Gas Engineer (Mr. J. M'Crae) and all the officials with whom he came into contact, and on whom the economical and successful management of their large undertaking so largely depended.

The motion was seconded by ex-Bailie MACDONALD, and adopted.

OLDHAM CORPORATION GAS AND WATER SUPPLY.

Annual Reports.

The Manager of the Oldham Gas and Water Works (Mr. H. Andrew) has prepared the following reports on the results of the operations of the two departments during the year ending March 25 last.

Referring to the gas-works, Mr. Andrew states that the expenditure on capital account in the past year has been £7020. The gross revenue for the year on gas-works account amounts to £123,233; and the gross expenditure to £106,578—the balance carried to profit and loss account being £18,654. Adding the interest on reserve fund account (£1053), makes £19,708. The annuities amount to £3591; the interest on loans and stock, to £8337; and the sums payable to the respective sinking funds to £5428—making a total of £17,356; the surplus on the year's working being £2351. The balance brought from the previous year's accounts was £5980, which gives a disposable surplus of £8332. The amount which can be paid to the borough funds from profits is £7177; leaving a balance to carry to the credit of next year's account of £1155. The quantity of gas supplied to the Corporation street-lamps and municipal buildings free of cost during the year was 62,016,000 cubic feet. The benefit to the borough fund for gas thus supplied, based on its selling price, is £6637. The amount of profits to be handed over, as stated above, is £7177; thus giving a total sum of £13,814. The quantity of gas manufactured at the different works during the year was: Oldham station, 186,515,000 cubic feet; Higginshaw, 390,981,000 feet; Hollinwood, 338,906,000 feet; and Royton, 49,536,000 feet—making a total of 969,938,000 feet, against 938,341,000 feet in the preceding year. The quantity of cannel and coal carbonized was 94,658 tons. The average quantity of gas made per ton was 10,204 cubic feet; and the loss of gas from leakage, &c., was 51,849,000 feet, or 5·367 per cent. of the quantity made. The maximum quantity of gas delivered in 24 hours was on Dec. 24 last—7,218,000 cubic feet, as compared with 6,018,000 feet in the preceding year; showing an increase of 1,200,000 feet. The minimum quantity of gas delivered in 24 hours was on June 28—660,000 cubic feet, against 624,000 feet; being an increase of 36,000 cubic feet. The average illuminating power of gas supplied was equal to 19·69 candles. In the course of the year, 541 new meters were fixed, and 525 consumers added. The total number of meters now in use is 44,272; and the number of consumers is 43,306.

The report with regard to the water-works states that the expenditure on capital account during the year has been £18,747. The gross revenue amounts to £53,953; and the gross expenditure, to £14,601—the balance carried to profit and loss account being £39,352, on which are the following charges: Annuities and interest, £28,244; sinking fund for the liquidation of debt on water-works, chargeable on revenue, £10,223—total, £38,468; the surplus being £883. The income during the year was £53,953, against £52,867 in the previous year. The water-rental during the year was (including meter-hire) £52,673, against £51,541 in the previous year, or an increase of £1131. There was an advance of £468 from the water-rents for domestic purposes, &c., and £662 from the supply for trade purposes per meter. The receipts from rental of lands, mills, cottages, &c., during the year were £1280, against £1325 in the previous year; being a decrease of £44. The expenditure was £14,601, as compared with £17,171. The number of houses supplied with water is 43,595; being an increase of 311. There are 1220 water-meters in use, against 1202 in 1890-1. The report concludes by mentioning that, on Sept. 30 last, the ceremony of opening the Castleshaw Water-Works was performed by the Chairman (Alderman Buckley, J.P.).

HEYWOOD CORPORATION GAS AND WATER SUPPLY.

Annual Reports.

The Manager of the Heywood Corporation Gas Department (Mr. W. Whatmough) has issued his report for the year ending March 25 last. It appears therefrom that the gross revenue amounts to £16,075; and the expenditure to £15,175—leaving a net profit of £900. The total amount of the reserve fund is now £3909; and the expenditure on renewal of engines, exhausters, boilers, and gasholder, out of this fund has been £3161—leaving a balance of £748. The total outlay on revenue account is £951 more than last year, £590 of which is due to the increased quantity of coal carbonized, and the additional cost per ton; the price being 13s. 0½d., as compared with 12s. 0½d. for 1891, and 10s. 11⅜d. for 1890. An increase of £178 for carbonizing wages includes £40 for further advance of wages, granted by the Gas Committee in November last. The total increased charge to this account in consequence of advanced rate of wages is £280, as compared with the

rate of payment before the first advance was conceded. The total amount realized for residuals is £2754, or an increase of £271 upon the previous year, notwithstanding a reduction of 1s. 2¼d. per ton in the price of coke, and 15s. per ton for sulphate of ammonia. The total quantity of gas made in the year amounted to 90,117,000 cubic feet; being an increase of 5,232,400 feet, or 6·16 per cent., and the average yield per ton of coal carbonized was 9629 cubic feet—the reduced quantity being due to the higher illuminating power of the gas supplied, and other causes. The average illuminating power for the year was 18·51 candles, as against 17·55 for 1891. The total quantity of gas sold reached 79,715,204 cubic feet—an increase over the previous year of 5,232,400 cubic feet, or 5·25 per cent., which has realized an additional revenue of £654. Of the gas sold 70,420,380 feet were used by ordinary consumers, and 4,228,200 feet for stoves and motive power; the former showing an increase of 5·54 per cent., and the latter 36·70 per cent. The quantity of gas unaccounted for is 9,576,146 feet; representing a leakage of 10·62 per cent. With regard to the department under their charge, the Water Committee report that the total payments on capital account during the year amounts to £2441. There has been an increase of 84 in the number of consumers; and it is encouraging to observe that the net receipts for water during the year are £343 more than in the previous year, and £727 in excess of the amount for the year ended March 25, 1890. Should this rate of increase continue, the receipts will in a few years' time be sufficient to meet the additional charges against revenue in respect of interest and sinking fund consequent upon the construction of the new works in the Naden Valley.

BELGRANO (BUENOS AYRES) GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Thursday, at Winchester House, Old Broad Street, E.C.—Mr. C. J. HEGAN in the chair.

The SECRETARY (Mr. H. M. Gerrard) read the notice convening the meeting; and it was agreed to take as read the report of the Directors for the year ending Dec. 31 last.

The CHAIRMAN, before proceeding to the consideration of the report, referred to the serious loss the Company had sustained in the death of Mr. F. A. Hankey, who had occupied the chair from the formation of the Company. With regard to the filling of the vacancy thus created, there were, he said, two shareholders who possessed good qualifications for the seat—Mr. J. T. Woolley and Mr. C. P. Ogilvie; and so the Directors thought they could not do better than elect them both. The last-named gentleman had a very practical and personal experience of Buenos Ayres; and as his business called him out there periodically—in fact, he was in Buenos Ayres at the present time—he would be of the greatest value to the Company. Turning to the events of the past year, the Chairman proceeded to remark that it was undeniable that it was a very disappointing period to look back upon. It was some consolation, however, to the Directors to feel that they were not alone in their misfortunes; every company doing business in the Argentine Republic being, to a greater or less degree, in the same position as themselves. The depreciation of the paper dollar had been their chief difficulty; and in the past three years, on this account, the receipts showed a falling off of something like 60 per cent. For such a state of things, there was only one remedy—viz., increasing the price of gas; but this was much easier said than done. The different Gas Companies supplying Buenos Ayres agreed upon a sliding scale for the formation of a new tariff. Although this was only a partial remedy (it would be impossible by any sliding scale to recoup themselves entirely for the loss occasioned by the depreciation of the paper dollar), it would have been a *modus vivendi*, and they could have gone on with it. The Municipality, however, stepped in, and denied the right of the Companies to increase the price of the gas without their consent. The Companies strongly protested, and were still protesting, against this. This attitude on the part of the authorities had caused great difficulty in getting the accounts paid by private consumers. But this was not the only trouble the Company had had with the Municipality. They had declared their concession at an end three years sooner than the Directors thought in justice it should have been; and they also allowed their accounts for public lighting to remain unpaid until the amounts due assumed formidable proportions. As a last resource, the only course open to them was to cut off the supply. The inconvenience to the public, not to say the danger, made the Directors very loth to take this step; but they had pointed out, both publicly and privately, that it must come to this, unless the accounts were paid. This seemed to be having the desired effect; for their last advices from the other side stated that negotiations were in progress which pointed to a speedy arrangement for the settlement of all arrears, and by which a fresh contract would be made for the public lighting—the contract which existed with regard to Belgrano having ended when the concession was terminated. The Directors did not consider that the lapse of the concession would interfere with the development of the concern. The concession applied only to Belgrano, where, having the field to themselves, they had little to fear from competition; whereas their progress took place almost entirely in Buenos Ayres, where competition was very severe, and where no company enjoyed any special privileges. The one feature which attracted most attention, he regretted to say, was the debit balance in the accounts of £13,928, which certainly looked very unsatisfactory, but it admitted of explanation. It was not a loss in trading, although it was in the profit and loss account; and it was explained by the large amount (£51,755) which it was necessary to write off on the other side in connection with the loss on exchange. The Directors looked forward, with the fullest confidence, to having a better statement to place before the shareholders twelve months hence than they had on the present occasion. In conclusion, he moved the adoption of the report and accounts.

Mr. J. T. WOOLLEY seconded the motion, which was carried unanimously.

The retiring Directors (Mr. A. Hooper and Mr. Woolley) and the Auditors were re-elected; and, after a vote of thanks had been accorded to the Chairman and Directors, the proceedings terminated.

THE METROPOLITAN WATER SUPPLY COMMISSION.

Monday, June 13.

(*Lord* BALFOUR OF BURLEIGH, *Chairman; Sir* G. B. BRUCE, *Sir* A. GEIKIE, F.R.S., *Professor* DEWAR, F.R.S., *Mr.* G. H. HILL, M.Inst.C.E., *Mr.* J. MANSERGH, M.Inst.C.E., *and Dr.* W. OGLE, *Commissioners.*)

The case for the London County Council was entered upon to-day; but before this was done,

Mr. *J. J. Francis*, Engineer of the New River Water Company, was recalled to supply supplementary information which had been asked for and promised concerning the standing water-levels, the ordinary pumping-levels, ground surfaces, &c., at the Company's works.

Mr. *W. E. Bryan*, Engineer to the East London Water-Works Company, was also recalled; having been requested to hand in a tabular statement, showing the amount of water supplied by the Company in 1891 for other than domestic purposes, and plans showing the position of rain-gauges and the rainfalls as recorded there. It being pointed out to witness that, in one instance at least, with more rain a less quantity of water passed over the weirs, he explained that it depended upon the part of the year at which the rain came whether the quantity flowing over was increased by the fall. If, for instance, much rain fell now, when the grass in the valley was long, it would scarcely produce any difference; but if it came in the early spring, it would make a considerable difference in the amount passing over each weir. On certain occasions, with a moderate rainfall, in the spring there was a great increase; and in the summer, before the hay was cut, a heavy rainfall made no perceptible difference.

The CHAIRMAN mentioned that there was another table to be handed in by witness. Taking certain parishes in his Company's district, he offered to have their supplies counted; and he was to see that these parishes were fairly typical.

Witness selected Bethnal Green and Poplar; and, in the former, the supplies numbered 19,141, and there were 17,109 houses according to the census; while for Poplar the figures were 8962 and 10,173.

The CHAIRMAN inquired what was the explanation of the circumstance that, in the one case the supplies numbered more than the houses, and in the other less.

Witness said he could hardly tell. He did not know whether large institutions had each been taken as one house, or as several.

In reply to Dr. OGLE, who observed that the census papers were not yet published for parishes, witness mentioned that he had taken the parliamentary districts as published in the preliminary census table.

The CHAIRMAN remarked that he found in this another of the many pitfalls with which the Commission met; and they might put on the notes that, so far as could be ascertained at present, the 10,173 should be 7404. In the country districts, he added, witness had taken the two parishes of Leyton and Walthamstow; and, for the former, the supplies were put down at 11,506, and the houses at 10,714.

Witness stated that the latter figure was taken from the census. In Walthamstow the supplies numbered 8799.

The CHAIRMAN asked if any allowance was made for uninhabited houses in these four totals.

Witness answered that some of the houses would be uninhabited from time to time.

The CHAIRMAN: But on any given day there would be always a certain number uninhabited?

Witness: There would.

What deduction then is to be made for that?—It is almost impossible to say; and I do not know how to arrive at it.

The CHAIRMAN: If we do not do something to eliminate the uninhabited houses, we shall get into error in two ways—over-estimating population, and therefore under-estimating the daily supply per head.

Dr. OGLE said he had added together the supplies given for the two urban parishes, making the total 28,103; the census put the population of these two parishes in 1891 at 185,515. Dividing, then, this number by the total supplies, he obtained 6·6 as the number of persons in the parishes per supply. In the same way, he dealt with the two rural parishes, where the total supplies were 20,305; and the population by the census of 1891 was 90,252—making 4·4 persons per supply. Next, he reminded witness that, in his former evidence, he stated that the number of London supplies was 104,000, and country supplies 68,310; and, then, multiplying the former by 6·6, and the latter by 4·44, and adding the results together, he found the population supplied by the Company was 689,696; while—the average daily supply of water in 1891 being 40,282,200 gallons—the number of gallons per head per day was 40·7. This figure was obtained by dividing the average daily supply by the population.

Witness objected to this calculation, on the ground that the inhabited houses and supplies were confused in it; and it was impossible to take two parishes and make them representative in the way done in the calculation.

The CHAIRMAN told witness that, before the Commission founded anything upon calculations of their own, they would take steps to have them checked in every possible way.

Dr. OGLE thought, if the parishes taken were not fairly representative, they should have some that were.

To further discuss the matter, the Commissioners retired for a few minutes, and then

The CHAIRMAN announced that they were going to take a little more time to consider the figures; but said it was quite clear, from what had passed on several occasions, that they must endeavour to find a method of getting information upon the important point of supplies and population in a way more accurate than they had yet managed. Possibly they might call in for consultation some of the officers of the Water Companies. But when they had made up their minds, they would, after full consideration, address a communication to the Companies for the information they wanted, having first carefully adjusted what they did require, so that there might be no difference of opinion about it, and so that every opportunity and sufficiency of time might be given for supplying the information asked for.

Mr. *A. R. Binnie*, the Chief Engineer of the London County Council, was then called.

The CHAIRMAN remarked that Mr. Binnie had handed in several voluminous tables and maps; and the Commissioners should require for the consideration of some of these a longer time than they had yet had, before they could question witness upon them with any useful results. There were, however, some parts of his statement that they might go into that day; but before doing even this, they should like a distinct explanation once for all of certain terms which witness used, in order that there might be no doubt hereafter as to what was signified by them. He employed the term "Municipal London," What area did he describe by that?

Witness replied that he used the term in common with the term County Council area. They were practically the same. There was a small district at Penge which was in dispute between the two areas (it is included in the County Council area, and not in the census); but, with that exception, the areas were coterminous.

Is Municipal London the area over which the County Council preside?—Yes.

Now you use the expression "Greater London." Do you mean London under the Metropolitan Police?—I do; the area taken in the census as 701 square miles.

Then there is "Water London." What is that?—It is the area as near as I am able to ascertain at present supplied by the Water Companies in contradistinction to the area over which they have parliamentary powers, which is given in the twentieth annual report of the Local Government Board as extending to 514 square miles. Then "Registration London" is practically the same as the area formerly spoken of as Municipal London.

Do you mean absolutely the same?—Absolutely, without the parish of Penge.

Sometimes you qualify the expression Registration London by the term "Inner Ring." Do you mean Municipal London?—Yes.

Then the "Outer Ring"?—That is the district outside Municipal London, but within the larger area which the census returns call Greater London, the police district.

Registration London, including the Inner and the Outer Ring, is the same as Greater London?—Yes.

I understand, then, that Registration London, with the term Inner Ring added, is the area of the London County Council?—Yes.

In further examination, witness pointed out that his information bore upon the number of persons supplied by the Water Companies, and the rate of the supply per head in gallons. He invited the assistance of the Water Companies to furnish him with data for 1861 and 1871; but he did not ask the same for 1881, thinking at the time he had the information already furnished in certain reports. This he had now reason to doubt. Having regard to this, he had found a difficulty in making calculations upon the cases he had set before the Commission. He could not reconcile the populations with the number of houses supplied, and both these with the quantity of water said to be furnished by the Companies.

The CHAIRMAN, noticing that witness referred, in the statements he had sent in, to two different sets of documents—the first being the various census returns since the commencement of the century, and the second the returns made at various periods of population, number of houses supplied with water, and the quantity consumed, as given by the eight Companies—inquired how the population was arrived at.

Witness said the "population" of the Water Companies varied; and he derived it from three distinct sets of calculation. In one table was given the quantities of water said to be supplied to London by the Companies, and the theoretical populations which would be supplied by these quantities, at 30, 32½, and 35 gallons per head per day. For 1891, according to the published returns, 182,456,905 gallons were supplied by the Companies; and the question arose, how many persons were supplied? If the rate of supply were 30 gallons per head per day, the number would be 6,081,896. Now, it was perfectly clear that this population did not exist in London, or in Outer London, or in Greater London, or in any other district supplied by the Companies. On the assumption that 32½ gallons per head was the supply, they had a population of 5,614,059. But this again was clearly an impossible population, because Greater London, which included the bulk of the water area—he might say almost the entire water area—contained only 5,633,000 people. If, again, they took the rate per head of supply at 35 gallons, and divided the 182,456,905 gallons by 35, they obtained a probable population of 5,213,054, which was, in his opinion, somewhat more likely to be correct than any of the other estimates.

The CHAIRMAN: That is in a subsequent calculation the figure you take as the nearest basis you can get for your future estimate?

Witness: It is one of them.

But the fact that the Companies' districts and the registration districts are not co-extensive, makes it extremely difficult, if not impossible, to get anything but on estimate?—Yes.

Asked how he arrived at the 182,456,905 gallons already mentioned, witness said the figure was compiled from the Water Examiner's monthly reports for 1891.

The CHAIRMAN: Have you the detailed figures for each Company before you, because, comparing your figures with all the Companies' figures, there is a discrepancy of about 400,000 gallons; and I should like to see where that arises.

Witness: I could work it out in detail.

I do not say the discrepancy is intentional; but I want it cleared up?—I have been feeling the difficulties as keenly as you have; and you will get all the assistance I can give you.

The CHAIRMAN, reverting to the figure 182,456,905, asked if there would not have to be some reduction made in the quantity to allow for slip in the valves and short stroke in the pumps.

Witness said no, because for years past the statements had been made by the Water Companies that they supplied certain total quantities; and they must have known either that these quantities were correct or that they were incorrect.

The CHAIRMAN observed that the East London Company claimed a reduction of 10 per cent., the Grand Junction 7½ per cent., and some other Companies 5 per cent.; and he inquired if witness allowed any such reductions? He wanted witness's comment on the point.

Witness said the reduction no doubt was perfectly correct. The only complaint he had to make was that all the returns to the Water Examiner had been knowingly incorrect. An engineer would not return a quantity of water pumped without deducting for the slip in valves; and no pump discharged the theoretical quantity of water.

The CHAIRMAN remarked it was quite possible there might be some misunderstanding about this; and he wanted to say, with all friendliness, that the Commissioners desired, if possible, to conduct this inquiry without any allegations of knowingly false returns. They did not want to raise up any unnecessary feeling in what was a very difficult investigation.

Witness said he felt that; but, on the other hand, in assisting the Commission, he could not but remark on the statistics on which he had to base his calculations.

Further examination of the tables being proceeded with, it was disclosed that the population of the Metropolis seemed to double itself in 40 years. The figures for 1841 were about double those for 1801; and those for 1881, double those for 1841. But the increase for the last ten years appeared to have been rather less rapid. Witness also noticed that the number of houses was increasing in a greater ratio than was the population; the tendency being for fewer persons to live in one house than was formerly the case. But this circumstance would not in his mind affect the question of water supply, because he rather based his calculations on the total population than on the number of persons per house. Entering into a further explanation of some of the tables sent in, he deduced that, in 1931, the population of Greater London would be between 10,966,000 and 11,877,000; and in 1941, between 12,977,000 and 14,312,000. Some details concerning the estimated water supply, he reserved for another occasion; his object that day being to take a comprehensive view only. He estimated that in Greater London, on a mean of estimates, the probable future population would be, for 1901, 6·7 millions; for 1911, 8 millions; for 1921, 9·6 millions; for 1931, 11·4 millions; and for 1941, 13·7 millions. Or, on another basis, in 1941 the total population of "Water London" might be estimated at 12,373,243; and the probable consumption at 35 gallons per head per day, would be 433,063,505 gallons. So he thought they would not be far wrong in assuming, comparing the Water Companies' returns, the area supplied, and the census returns, that the consumption was at the rate of 35 gallons per head per day at the present time. He had not been able, up to the present, through stress of other matters, to make a division between domestic and trade consumption. His experience had taught him it was exceedingly difficult, if not impossible, when a certain consumption of water had been established, to reduce it to any very material extent, owing to habits of greater cleanliness being inculcated. His efforts in this direction in Bradford had been partially successful; yet in those portions of the town where modern houses, provided with baths and water-closets, were in full use, and supplied under constant pressure, he was unable to reduce the quantity per head per day much below 35 gallons for strictly domestic purposes. He would mention, as being instructive figures, that in Marseilles the consumption was 99 gallons per head per day; in Paris, 47 gallons; in Washington (U.S.A.), 154 gallons; in Detroit, 126 gallons; in Chicago, 95 gallons; in Boston, 76 gallons; in New York, 65 gallons; and in Philadelphia, 56 gallons. In Dublin it was 47 gallons daily; in Glasgow, 50 gallons; and in Edinburgh, 40 gallons. He remarked that it should not be forgotten that London, as compared with continental cities, was far behind in appliances for the public distribution of water for ornamental, sanitary, and cleansing purposes; and compared with only one example—notably that of Paris—it might be said to be deplorably in the background. Paris employed for public purposes, on an average, about 18 gallons of water per head of the total population per day; while London probably did not use one-twentieth of this quantity. He consequently felt that it would not be safe to reckon in the future on a less quantity than 35 gallons per head per day for so important a city as London. Although for the sake of comparison, he had given estimates of consumption in the future at rates of 30, 32½, and 35 gallons per head per day, yet he considered the latter to be the most reliable; and he would, but for the fact that 35 gallons appeared to be the present actual rate of consumption, have preferred to base his estimates on a total of 40 gallons per head per day. He considered that, if 35 gallons were taken as the basis of calculation, it would permit, on the one hand, of some slight reduction due to savings which might be effected in the prevention of waste, while, on the other hand, it would provide for a more legitimate use of water generally for all purposes. In all estimates as to the future of London, they were looking to a time when water would no longer be the luxury of the rich; and he referred to the cases in the United States as showing that, among a democracy, that state of things had been arrived at for which they were striving. In England it might be called waste; but he thought it was one of the problems of the future which they would have to face.

The CHAIRMAN said, without wishing to enter into an argument, he must remind the witness that, to go into such matters as the figures in American cities would take them into a wide field of investigation; as climate, temperature, and so on, would be important factors.

Witness remarked that, as to increase of population in London, he certainly did not think it was fair to be guided by the increase in the outer ring merely, but to take the mean increase of population of the inner and outer ring.

Dr. OGLE: Of course, all estimates of growth of towns in the future are more or less speculative. Do you not think it is almost too speculative to judge as to what would be the case fifty years hence, on a basis of what has happened in the last ten years?

Witness replied that he saw nothing to lead him to suppose, taking London as a whole, that it would not go on increasing; but he would admit that, the farther one looked into the future, the more speculative it became. He might state, however, that the County Council felt that they would in the future be the custodians of the water supply, and, by an express resolution of their Committee, they wished to look fifty years ahead; and he had endeavoured to carry this out.

Dr. OGLE: In one of your methods of estimating the future, you take the number of acres in the outer ring and the density of population per acre, and you apply it to that portion of the Water Companies' area which is outside of London?

Witness replied that this was so; but he was most anxious not to appear

to make his estimates of the population too low, as compared with those of the Water Companies. The Companies' estimates were vastly too high; and he was anxious to take a moderate view. But it was quite correct to say that the 3·83 was the average of the whole of the outer ring, while no doubt the population supplied was in a denser district; and it would not be fair to apply to West Ham a density per acre which was obtained from the highly rural parts of the outer ring. As to the distinction between the number of supplies and the number of houses served, he was not able to draw it. The Water Companies had, however, for years past returned the average number of houses supplied; and there must be some basis of truth in that return. He could not believe that eight great public Companies in London year after year sent to Her Majesty's Government returns under that heading if there was no semblance of truth in them. He thought that, unless the Commission had before them a map on a sufficiently large scale to show the pipes of distribution and each house supplied by the Companies, they would be unable to unravel that difficulty.

Dr. OGLE reminded the witness that representatives of one of the Companies had stated that, by the introduction of the waste-meter system in their district, they had materially reduced the quantity of water consumed per head.

Witness replied that this was true; but he agreed with the evidence of his friend, Mr. Bryan, that, as fast as the waste was reduced to certain theoretical low limits, the habits of the population tended to drive up the consumption. They could, however, do something. They could, for instance, very largely reduce such waste as was caused by leakage through public pipes; but as to domestic consumption, though he would not say it was useless, it was a very uphill battle.

In reply to Mr. MANSERGH, witness said that in Bradford he had brought the supply down from 24 to 20 gallons per head per day; but getting that average meant that many consumers were having only 6 or 7 gallons daily—Bradford not being a water-closet town. But the whole of London might be said to have a water-closet system. In addition to the 20 gallons per day for domestic purposes, a similar quantity was consumed in Bradford for trade purposes.

In reply to Mr. HILL, witness stated that he thought the consumption in London might be reduced a little by proper inspection and examination of water-fittings; and he was certainly startled by the evidence of Mr. Bryan as to the bad fittings at the East-end. His estimate of 35 gallons per head per day for London was for all purposes—trade, domestic, and public. But he expected a large increase for domestic use. There were 5 million persons in London; and he had taken some trouble to ascertain what quantity of water was used in private and public baths. He found it varied from 100 down to 75 gallons. Supposing it were 75 gallons, and everybody in London had a bath, 375,000,000 gallons of water would be required per diem. Of course, they could hardly suppose that everyone would have a bath. They might assume, however, that in the future there would be a bath in every house; and if there were seven persons in each house, and the bath was used once a day, so that each had a bath once a week, 55 million gallons would be needed. It would therefore require, for bathing purposes alone, 11 gallons of water per head. He did not contemplate any increase in regard to water-closet supply, as London, as he had already stated, had a water-closet system. The figure 7·6, the number of persons to each house, was taken from the census returns, and was the mean of Inner London. He could not tell what proportion of this area was now built over. He had been trying to ascertain, but found it exceedingly difficult. However, if the Commission would accept a very rough figure indeed, he might state that about 20,000 out of 77,000 acres still remained to be covered. It was frequently said that estimates which were based on a past increase in population were useless for future guidance, because London was becoming so rapidly built upon as not to allow of a very much larger population than it at present contained. Witness put in a table which showed that, supposing that Greater London were populated at the same rate per acre as the registration district of Whitechapel, it would be capable of containing a population of 87,000,000 persons; if as densely as the registration of Westminster, 76,256,000 persons; if as densely as the Chelsea registration district, 53,500,000 persons; if as densely as the Kensington registration district, 33,500,000 persons; if as densely as St. George's, Hanover Square, with all its open squares, broad streets, and portions of some of the public parks, 30,500,000 persons; if as densely as the comparatively suburban districts of Greenwich and Fulham, from 20,000,000 to 21,000,000 persons; and if as densely as Hampstead, 13,500,000 persons. It would be noticed that the most extreme estimate for Greater London in 1941, of 17,500,000 persons for an area of 701 square miles, could be accommodated within such area without their being so crowded as they now were in the suburban district of Fulham, a large portion of which was not yet built upon.

The CHAIRMAN remarked that the consideration of the chalk wells in and around the county of London would be best dealt with when the scientific and geological section of the inquiry was embarked upon; and as to that part of the evidence of the witness which dealt with the abstraction of water from the Thames, the Conservancy were going to give evidence the next day, and the Commission thought it better to take the information from that body in the first instance.

Witness then remarked that, with regard to 100,000,000 gallons of water a day being abstracted from the Thames by the Southwark and Vauxhall, the Lambeth, the Grand Junction, the West Middlesex, and the Chelsea Water Companies "under agreement," he should ask for the production of the agreement, as he could not believe in its existence until it was placed before some tribunal. Last year the Companies were challenged in Parliament to produce it; but they did not do so.

The CHAIRMAN said the Commission had been furnished with a copy.

Witness then stated that, under the Act of 1867, the East London Company abstracted from the Thames 10,000,000 gallons of water a day; and, under an agreement of 1886 with the Thames Conservancy, the Southwark and Vauxhall Company abstracted 4,500,000 gallons daily; the Lambeth and Grand Junction, each 4,500,000 gallons. Under the head "West Middlesex," he disputed the figure of 4,500,000 gallons which had been stated. If the Commissioners would refer to section 8 of the West Middlesex Company's Act of 1886, they would see that the Company were, in express statutory terms, restricted to 20,000,000 gallons a day. The section ran: "The Company shall not at any time take from the River Thames any water in excess of the quantity of 20,000,000 gallons a day which, under agreement between the Company and the Mayor and commonalty and citizens of the City of London, now represented by the Conservators of the River Thames, the Company are now authorized to take." He said, therefore, that neither the Thames Conservancy Board, nor the Companies, nor Sir Henry James, could set aside a statutory provision. Under the head "Chelsea," he did not agree with the information laid before the Commission that 2,000,000 gallons of water a day, in addition to the 20,000,000 gallons, were taken under agreement by the Chelsea Company. As the Commission would see by referring to the 25th section of the Chelsea Water-Works Act of 1875, this would be contrary to the Act. Witness then handed in a table showing "dates upon which the Southwark and Vauxhall Water Company drew more than the statutory quantity of water from the Thames." The figures given were from the monthly reports of the Official Water Examiner. From them he drew the inference that the Company had no hesitation whatever in exceeding their statutory quantity of water. In July, 1878, the Southwark and Vauxhall Company, according to the returns made to the Local Government Board, drew from the Thames daily an average quantity of 25,196,388 gallons. At other times, according to their own showing, they were restricted to 20,000,000 gallons a day. The allegation was that throughout the month of July, 1878, they drew on an average 25,000,000 gallons a day.

The CHAIRMAN remarked that the question of the abstraction of water from the Lea and the Thames he avowedly postponed until the Commission had had the evidence of the Conservancy; but he wished the last-mentioned tables to be put in, in order that, they having been before the Commission, the members might have an opportunity of examining them.

The Commission then adjourned till the following day.

Tuesday, June 14.

On the re-assembling of the Commission to-day, the case for the Thames Conservancy was taken.

Mr. *J. H. Gough*, Secretary to the Conservancy, was the first witness called. He said that the Conservancy had put in statements in reply to queries of the Commission; and he had lodged copies of the agreements mentioned in those statements dealing with the amount of water which the respective Companies might take from the Thames. One of the paragraphs ran thus: "In the Acts, the Companies have statutory rights to take water without limit, and it is only by the agreement that they are restricted as to quantity; the Acts merely providing an ample saving clause for the rights of the Corporation of London as Conservators." These Acts were named in the deposited statement; but as there seemed to be some difficulty in grasping the position, he explained that, after the passing of the Metropolis Water Supply Act of 1852, the Companies moved their intakes above Teddington, and then they obtained power to take water without limit. That power existed up to 1866, when the Conservators availed themselves of a Bill, which was introduced by the West Middlesex Water Company, to confer on them various fresh powers, to ask Parliament to insert a clause to confirm a limit of 20,000,000 gallons per day imposed by an agreement made between the Company and the Corporation of London when the latter were Conservators of the Thames. This was in 1852; and, by the agreement, the Company were bound to limit their power to take water without limit to 20,000,000 gallons. The clause was inserted and became law. Subsequently to this, other arrangements were made between the Companies and the Conservators. The circumstances which led up to these were as follows: In the year 1866, when the Board of Trade transferred the Conservancy jurisdiction of the river above Staines, they applied to the Water Companies, and the five Companies agreed to pay £1000 a year to the Conservators for the maintenance of that part of the river. Then in 1867 the East London Water-Works Company applied for powers to take a supplemental supply from the river at Sunbury; and they agreed to pay for it £1000 per annum, which was to rise eventually to £2000. Next, in 1878, the Conservators applied to Parliament for an additional income; and then the Companies agreed to pay £1000 a year in addition to the amounts already paid. But these amounts of £12,000 were after a time found to be insufficient; and in 1886 the Conservators were proposing to apply to Parliament for extra contributions from the Companies. The Companies had interviews with the Conservators; and they eventually agreed to pay a further sum of £4500, which was made up of the sum of £500 additional from the Chelsea Company, making £2500 from that Company in respect of the Upper Navigation Fund, and £1000 each from the other four Companies—the Grand Junction, the Lambeth, the Southwark and Vauxhall, and the West Middlesex. The East London Company declined to pay any more money. The total annual contributions from the Companies then were: Chelsea, £2500; East London, £2000; and each of the other four Companies, £3000 to the fund. By the old agreement of the Lower Navigation Fund (the fund applicable to the river below Staines), the Companies paid as follows: Chelsea, £300; Grand Junction, £300; Lambeth, £250; Southwark and Vauxhall, £300; and West Middlesex, £300—making in all, £1450 to the lower fund. Witness explained that in the case of the Companies restricted by statute to a certain quantity of water, such as the West Middlesex, the Thames Conservancy had, by agreement with them, given them power to draw more. Asked under what statute the Conservancy were acting in that, witness stated they had under their consideration at the time the whole of the powers which they possessed; and by the Act of 1878 there was conferred, by section 15, a power of inter-sale between the Companies. Subject and without prejudice to all other terms and conditions contained in any subsisting agreement or Act, it was provided that it should be lawful for any one of the six Companies to supply any part of the total quantity of water which the Company were empowered to take from the Thames, or any tributary, and which was not required for the purposes of their district, to any other of the Companies. And the Conservators, under that power, and under their general powers, felt that they were able to grant an additional supply of 20,000,000 gallons per day.

The CHAIRMAN inquired if the Act of 1878 was the Act for the interpretation of which the arbitration was held before Sir H. James.

Witness said it was pleaded before Sir Henry James; but he did not know if section 15 was pre-eminently before him. The Conservators were not parties to the arbitration. Under the Metropolis Water Act, the West Middlesex Company required to seek the arbitration as to the legality of the payments. The Conservators were not parties in the matter, nor were they allowed any *locus standi*.

Was there any other power which the Conservators had to give water from the Thames, except that conferred by this section of the Act of 1878?—As I apprehend, there was no power except that contained in the Act of 1852 and the Acts of 1866 and 1875; the two latter Acts being those by which the Companies were restrained from taking more than 20,000,000 gallons per day from the Thames.

The CHAIRMAN remarked that, as he read the section, but without attempting to give any legal opinion, which he certainly would not think of doing, it seemed to him that the only power given to the Conservancy was not to add to the total amount of water taken, but to re-allocate between the Companies the quantity which they might take.

Witness thought the view would be this—that to the three Companies and to the East London Company there was an unlimited supply in times of flood; and the Southwark and Vauxhall, the Lambeth, and the Grand Junction Companies were able to take a quantity without limit, except so far as the Act of 1852 restrained them. Those Companies could draw a large quantity; and there was a power of inter-sale between them and the other Companies.

You mean that, some Companies being limited and some being unlimited, according to your view the Thames Conservancy have the right to transfer to the limited Companies such proportion as they choose, and as the unlimited Companies may take?—Precisely. In the first instance, the Conservators decided simply on a bulk amount of 20,000,000 gallons a day; and the apportionment of the amount was a matter for future arrangement with the Companies between themselves.

Surely the apportionment is distinctly over and above the 20,000,000 gallons in every case?—In the first instance, the Conservators agreed to the 20,000,000 gallons; and then the agreement set out afterwards, by arrangement with the Companies, the 2,000,000 and 4,500,000 gallons respectively.

But in addition to the initial 20,000,000 gallons?—No; that was the apportionment of it. There was first 110,000,000 gallons; then the Conservators agreed to 20,000,000 gallons more, which was apportioned in the quantity set out in the statement put in.

I fear there has been some misunderstanding. Is the position not this: Under agreement with the Corporation of London, dated 1852, five Companies take 20,000,000 gallons a day; under the Act of 1867, the East London Company take 10,000,000 gallons a day—the total authorized, as given before the Royal Commission in 1869, 110,000,000 gallons a day; under agreement with the Thames Conservancy in 1886, four Companies each take 4,500,000 gallons a day, and the Chelsea Company, 2,000,000 gallons?—Yes.

But these quantities of 4,500,000 and 2,000,000 gallons are distinctly over and above the first 20,000,000 gallons?—Certainly.

Then how can you say that there was a re-allocation between the Companies of any part of the 20,000,000 gallons?—I say that the sum of these quantities is 20,000,000 gallons, and it was granted by the Conservators first on the initiative of the Companies; and this amount, which they felt they had power to grant to be taken out of the river, was apportioned in the various quantities set out. I am not speaking of the 20,000,000 gallons granted to each of the Companies, but of the 20,000,000 in addition to the 110,000,000 gallons.

I see you claim the 20,000,000 gallons in place of the 110,000,000 gallons?—In addition thereto.

Witness then, in reply to a request to explain exactly under what authority the 20,000,000 gallons was claimed, said it was claimed to be given under the powers which the Conservators had. They were not restrained in any way by their own Acts from granting an additional supply of water. But the Water Companies originally had unlimited power. This remained to three of them; the other two—the West Middlesex and the Chelsea—were restrained by clauses inserted in subsequent Acts. Those three Companies could take water to any extent, except for the agreements with the Conservators. Then the Conservators granted 20,000,000 gallons more to the Companies in block beyond the 110,000,000 gallons; and this 20,000,000 gallons was apportioned by a subsequent arrangement between the Companies.

The CHAIRMAN again asked how far the Conservators were acting under the statutory powers they had to give water, in granting 20,000,000 gallons a day, and how far they were simply regulating the power which the unlimited companies claimed to have, of taking their unlimited supply.

Witness said he knew of no powers whatever—no specific powers—by which the Conservators were able to give any quantity of water; but he knew that the Companies, as he had already said, had unlimited powers—only limited in the first instance by the action of the Corporation of London in 1852, and by the Conservators applying to Parliament in 1866 and 1875 for the confirmation of the agreements—and that the Conservators could, by the agreement entered into with the Corporation in 1852, regulate the three Companies which he stated were unlimited. With regard to the considerations which guided the Conservators in giving the water to the Companies whose powers Parliament had restricted, they felt that the clauses were introduced at their instance only, and that those in the Companies' Acts were merely for their protection, in order that the *régime* of the river should not be prejudicially affected, so far as they could prevent. They considered the question of what would be the effect of granting 20,000,000 gallons more to the whole of the Companies; and they came to the conclusion that it would not prejudicially affect the river. There were other bodies besides the London Water Companies which took a supply of water from the main stream of the Thames—the Oxford Corporation, for the supply of the city of Oxford; the Windsor Corporation; the South-West Suburban Water Company; and the West Surrey Water Company. The Oxford Corporation were entitled to take as much water as they required, free of payment, and by a main-pipe not exceeding 24 inches in diameter which would allow a maximum of 5,500,000 gallons daily; the West Surrey Water Company, 3,000,000 gallons; the South-West Suburban Water Company, 1,000,000 gallons—making a total of 9,500,000 gallons. The Windsor Corporation's quantity was undefined; but none of it was taken direct from the river.

The CHAIRMAN pointed out that the Windsor and Eton Water Company took water from land belonging to them, but not from the river direct, and he asked for information concerning this source.

Witness said he was afraid he could not say very much about this. Several years ago, the Company applied to Parliament for additional powers. The Conservators of the Thames opposed the Bill; but their petition was dismissed. The preamble of the Bill was proved; and all that the Conservators knew was that the Company had power to pump water from the soil. He believed the water was drawn from deep wells in the chalk; but he was not certain. The London Water Companies and the other bodies named included, as far as he knew, all those which took water from the stream of the Thames for supplies. As to the statement frankly made by some of the Water Companies, that they took water from gravel-beds at various points not far from the Thames, the Conservators had no official knowledge of what the Companies were doing in this respect, except with regard to the Southwark and Vauxhall Company. Witness next gave information concerning the character of the sewage works of towns on the Thames and its tributaries above the inlets of the Companies; and he pointed out that, without efficient inspection on the part of the Conservancy, it would be unsafe to rely upon what occurred at the effluent of some of the works. Speaking of the paper-mills on the river, he said they were most carefully looked after with respect to impurities proceeding from them into the stream; and the Conservators had also to watch 750 scattered houses and farms, the sewage and waste from which they had caused to be diverted from the river. Another aspect of the question of pollution was that of the discharge from house-boats. These had had to be watched most carefully, more particularly because there had been assertions from time to time that there was a large mass of pollution from them. The manure and cabin barges formed an infinitesimal portion of the craft on the Thames. The principal part of the barge traffic was in open barges, without sleeping accommodation in them. Witness also gave it as his undoubted opinion that the raw water of the Thames had improved in quality in recent years.

Mr. *C. J. Moore*, M.Inst.C.E., the Engineer to the Thames Conservancy, supplied information as to the gaugings at Teddington Weir, and as to the flow of water there after the abstraction of the Water Companies' supplies. The average volume on seven consecutive days had fallen as low as 179,600,000 gallons. This occurred in August, 1887. Having regard to all the circumstances, the present maximum of 130,000,000 gallons, which the Companies might abstract from the river, was the most which, in a dry season, should be allowed to be taken out by them. At times other than dry seasons, more might be safely drawn having regard to other interests involved in the river. The statement that one or other of the Companies pumped, from the gravel-beds close to the Thames, water that was passing away from the river, he could not understand. He thought such water, if left alone, must go into the river.

In reply to Mr. MANSERGH, witness admitted that the abstraction of water by the Companies must affect the Thames slightly, but not very far down. If 500,000,000 gallons were coming down, and 100,000,000 gallons were taken out, the surface of the river would be lowered about 4½ inches; and if the total which might be abstracted by the Companies—130,000,000 gallons—were taken, it would make a further difference of 1,500,000 gallons. The difference would diminish as the stream flowed, till at Hammersmith there would be little effect at all.

Mr. *C. E. Groves*, F.R.S., the Consulting Chemist to the Thames Conservancy, was likewise examined. He said he did not dissent from the view that the water of the Thames had been improving; and he was satisfied that it was not rendered materially bad by the matter passing into it. There had, however, been no systematic chemical examination of the water from time to time, which would establish these views. The impurities might be regarded as of two kinds—dead matter and living organic matter; and the former was not likely to prejudicially affect the water. The bacteria would be of two kinds—one which would produce disease, and one which would not. The latter, indeed, was rather beneficial than otherwise, because by it, so far as they knew at present, organic matter was destroyed; and the former seemed to be got rid of when it came in contact with light and air, which it did in passing over weirs, &c.

The Commission then adjourned till yesterday.

Neath Gas and Water Supply.—At the monthly meeting of the Neath Town Council yesterday week, the Gas Committee recommended that the necessary steps be taken for applying in the next session of Parliament for additional borrowing powers for gas-works purposes; the powers contained in their Act of 1874 having become exhausted. The sum proposed to be borrowed was £30,000. They also presented a report on their operations during the past financial year. The gross profit, after meeting all expenses, amounted to £1907; being a decrease of about £90. There had been an increase of £428 in the cost of manufacture; coals cost more, due to the larger quantity used; wages had been higher; and wear and tear had increased by £150, owing to a considerable extent to the floods and gales which prevailed some time since, when the town was almost in darkness. On the other side, a steady increase in the gas-rental of about £320 was shown; and although the prices of residuals, tar in particular, were at present very low, they exhibited an increase of about £80—this being due, to a great extent, to the more efficient apparatus used now than formerly. After some discussion, the report was adopted; but the recommendation as to additional borrowing powers was deferred for further consideration. Pursuant to notice, Mr. Cuthbertson subsequently moved that the purchase-money of £47,000 be paid to the Neath Water Company for the whole of the undertaking in Neath, Briton Ferry, and Skewen, subject to a satisfactory arrangement being come to with Mr. C. E. Thomas, for a sale or lease of the filter-beds to the Corporation. There was no seconder, and therefore the motion fell through.

SOUTHWARK AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held last Tuesday—Alderman Sir H. E. KNIGHT in the chair.

The SECRETARY (Mr. A. Jelley) having read the notice convening the meeting, the report of the Directors and the statement of accounts were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, stated that the latter showed that the Company was still pursuing its steady progress, and enjoying that prosperity which had attended it for so many years. Savings had been effected in the pumping and engine charges, to the amount of between £1100 and £1200, owing to the good contract made by the Directors for the supply of coal, and also to the greater economy that had been caused by the new engines which their Engineer (Mr. J. W. Restler, M.Inst.C.E.) had constructed. Altogether, the savings under these heads amounted to close upon £2000; but the increase in the rates and taxes, compared with the amount the Company had had to pay for the corresponding period of 1891, had reduced them by one-half. The figures under the head of management were within a few pounds of what they were a year ago. He was happy to inform the proprietors that the water-rents accrued to the date of the accounts this year had been £106,899; showing an increase, compared with the corresponding period of last year, of about £2000, which represented £4000 a year—this being the normal increase in the revenue. It appeared to be generally maintained; and he thought it was satisfactory. They had also the satisfaction of seeing that the allowances were again a little lower than they were a year ago; and out of the £8000 set aside for this purpose, they had been able to save £3477. This left a balance of profit of £58,000 to transfer to dividend and interest account; showing that they had made about £3000 more than they did in the corresponding half of 1891. But although they carried forward this increase in the profit, the amount available for dividend was only £34,500, against £40,000 a year ago. The explanation of this, however, was simple, and was due to two items. In the first place, they had had to pay more interest on the debentures they had issued for the construction of new works; and in the next place the decrease was due to what he could not but feel was the unjust expense which was put upon the Company year after year through the opposition brought against them by various public bodies. That a Company like theirs—honestly pursuing its course, and doing its duty satisfactorily in every way—should be laid open to attacks which threw upon it an expense of about £3000 per annum to defend its position, was most unjust. If two men went to law, the one who was beaten had to pay the costs of both sides; and he could not but think that it would be just and equitable that a public body, when they attacked a Company like this, should be made to bear the costs when they were defeated. It was a matter that would have to be seriously considered. He could not see why it was that a concern working honestly under its Acts of Parliament should have its profits diminished by attacks being made continuously on it, and charges made which were never substantiated in the end. The Company were able to declare the same dividend as in the previous half year; but had it not been for the circumstances mentioned, they would have paid an increased dividend, and been accumulating a little surplus besides. The results had fully borne out what he anticipated many years ago; but it was impossible for him or anyone else to fight against unforeseen contingencies. With reference to the London Water Bill, it was successfully resisted by the Water Companies; and the Committee of the House of Commons were by no means in favour of it. The only clauses in the Bill that were brought forward were struck out, excepting those which enabled the London County Council to spend £10,000 of the ratepayers' money in making an inquiry as to the Water Companies. In other words, it was giving them public money to harass undertakings like their own. The Committee, however, limited the expenditure to £10,000; so that if any more money was wanted, the County Council would have to go to the House of Commons for a further grant. Under the circumstances, the result was as good as the Companies could have anticipated. On all other points, the Committee were with the Companies. In regard to the question of the purchase of the undertakings, the County Council seemed to have the impression that the ordinary course pursued under such circumstances, as directed by the Lands Clauses Consolidation Acts, would not suit them; but, as was said by one of the members of the Committee, he believed they wanted to purchase the works of the Companies and to be their own arbitrator. This principle had been condemned twice by the House of Commons, who would not hear of it; and he (the Chairman) believed, if the time ever came for the Companies' properties to be bought up by any public authority, that they would find the purchase would have to be effected in accordance with the fair and equitable procedure which had been adopted for so many years past. With reference to the Royal Commission which had been appointed to inquire into the present sources of supply of the Water Companies, it was difficult for him to say much about the matter; and it would not be becoming in him to forecast what the decision might be. The Commission were giving earnest attention to the question submitted to them. The Companies had appeared before them in support of their case; and he must say that, from what he saw of the proceedings, the care and attention given by every member of the Commission were such that they might feel thoroughly satisfied that nothing would be left undone by them to arrive at a decision on a substantial basis. In their own case, they had been enabled to prove to the Commission that, by their powers, the works they had in hand, and those which they could carry out under the Acts they had obtained in recent years, they had not only ample water at their disposal to supply all the possible wants of the community for the next 40 years, but he thought that, if he doubled this time, there was not the least doubt, as far as their Company was concerned, that they would have ample water without going to other sources than those which they had at present at their command. He thought those who had followed the reports of the case presented by the other Companies would find that the latter were in a similar position; and he had not the slightest doubt—at any rate, as far as he was able to judge from the case of their own Company—that there was at the door of Londoners ample water for all their requirements for centuries to come. The Commission had heard the case of the Companies, and had received them with every courtesy. The proprietors would have seen, by the reports which appeared in the papers, that the case of the London County Council was under consideration on the previous day. He did not propose to make any remark as to what occurred on that occasion; but he could not but think that the gentlemen of reputation, the professional advisers of the Water Companies, who had put their statements before the Commission with a due sense of their responsibility, and their knowledge from their connection with these concerns for a long series of years, must be more capable of arriving at the facts than gentlemen who had had comparatively little knowledge of the position and interior working of the Companies, and who had simply picked up their facts from published statistics which might be found available. Up to the present time the Companies had not put before the Commission the evidence of the geologists and other scientific gentlemen; and, as a matter of convenience, this evidence had been left to the end of the inquiry, when it would be received on behalf of the united Companies. He did not himself think they had anything to fear from the report of a body of gentlemen constituted like the Commission; and he looked forward without any fear to their report. He believed the public would be surprised to learn that London was well placed for its supply of water for many centuries to come; and they would find that the reports to the contrary had been made indiscreetly, and without sufficient evidence as to the real facts. The Company, as the shareholders would find if they referred to their accounts for many years past, was in a sound and strong position, and steadily progressing; and they would have been paying a much larger dividend long since but for circumstances over which they had had no control, and which no one could have anticipated. He did not know that he need say anything further with regard to the contemplated purchase of the Companies' undertakings. He had often spoken upon this question; and they had constantly before them small cases of such transactions. They had in times past had principles laid down upon which such undertakings should be purchased; and in *The Times* of that day they would find a report relative to the purchase of an undertaking at Accrington, where the terms agreed upon had been 30 years' purchase. The principles upon which these works should be bought up were well defined; and, without repeating what he had already said, he had no doubt that, when the time came, those principles would not be departed from.

Mr. C. M. VIALLS seconded the motion.

The CHAIRMAN, in answer to questions, stated that the arrangement which had been made for obtaining the additional land for the Company's requirements were regarded by the Directors as advantageous, and such as would promote the interests of the concern. They had been endeavouring for years to get rid of the Battersea station altogether, as they considered that it was too near town. They had 40 acres of very valuable land there; and they had been working for an end which he believed would come in time. They might receive £300,000 or £400,000 for this land; and the money would be used for the construction of works which might be necessary for the purpose of the Company.

The motion was then put and carried unanimously. Dividends were afterwards declared for the half year at the rates of 5 per cent. per annum on the preference, and 6½ per cent. per annum on the ordinary stock and class "D" shares of the Company; and the proceedings closed with votes of thanks to the Chairman, Directors, Engineer, and staff.

GRAND JUNCTION WATER-WORKS COMPANY.

The Ordinary Half-Yearly General Assembly of this Company was held last Wednesday at the Offices, 65, South Molton Street, Brook Street, W.—Mr. FRANCIS TAGART in the chair.

The SECRETARY (Mr. J. W. Fisher) having read the notice convening the meeting,

The CHAIRMAN expressed regret at the absence, through a long and severe illness, of the Chairman of the Company (Mr. C. J. B. Hertslet). He was also sorry to inform them that Lord Knutsford had written stating that he could not be with them that day owing to a Cabinet Council; the present being the first time since he was elected a Director in 1875 that his Lordship had been absent. His colleagues had therefore asked him (Mr. Tagart) to take the chair; and he hoped they would make allowance for any shortcomings on his part. He thought that the accounts were, taken on the whole, satisfactory. It was not necessary for him to go through them; for there was only one item which differed very much, as compared with the corresponding period of last year. He referred to the sum of £1462, which had been charged against the revenue account in connection with the Dorney scheme of 1888. The shareholders would remember that that scheme was fully explained to them at the time; and it met with their approval. They promoted a Bill in the House of Commons in connection with it; but it was rejected upon the second reading—to their great disappointment, and, he might add, their great surprise, for it was an unusual course. They were not allowed to enter upon the merits of the scheme. Although they had kept it in existence for some time, they felt that they must now close the account. It had cost them a pretty round sum of money; but he thought that, as men of business, they would not lament this, because it went to show that the Company were then alive to their duties, and not indifferent to the future. The outcome of the half-year's working was that they were enabled to offer a dividend at the rate of 8½ per cent. per annum. A year ago, he believed, their dividend was reduced; but the Chairman then explained that this was owing to exceptional circumstances, which had turned out to be the case. This year they had fairly earned the dividend mentioned; and he hoped this result would be satisfactory to the shareholders. They would remember that some three years ago they gave the Directors power to raise £50,000 of share capital. They did not think it necessary to avail themselves of the whole sum at the time, and the £20,000 which they limited themselves to had carried them on fairly well; but they now considered it was advisable to raise the balance of £30,000. As stated in the

report, they had had large works in hand. The Board thought that the works should be kept up to the mark; and he felt sure that the proprietors would agree with them in this. It was also necessary to have a little working capital. Although it was usual in large companies like theirs, he thought it was not desirable for them to be under obligations to any considerable extent to their bankers. With reference to the constant supply, it was introduced partly at their own initiation; and they proposed to bring the whole of the district under this system. It was very good and beneficial no doubt to have the constant supply—that was, provided the fittings were well adapted to it, because if they were not, the constant-supply system might be wasteful without being healthful. After the very great attention which had been called to the water supply of the Metropolis, it was not surprising that the Government should have appointed a Royal Commission to inquire into the matter; and the Commission, composed of able and impartial men, were at present pursuing a very searching investigation. In the first instance, it was natural that they should ask the Water Companies for a statement of their position. They did not, however, give very much time in which to prepare evidence; but the Company's Engineer (Mr. A. Fraser) presented the Directors very soon with a report setting forth what the Company had done from the beginning, what they were doing now, and what they proposed and hoped to do in the future. He would do an injustice to Mr. Fraser if he were not to say that his report was a very admirable one. It was considered by the Court with full deliberation, in the presence of their Secretary, and with the invaluable advice of their Solicitor, Mr. Bonnor Maurice; and, with very few additions and alterations, it was sent on to the Royal Commission. Subsequently to that—after the drafting of the Directors' report, in fact—Mr. Fraser was examined before the Commission, when he amplified and fortified his report. A similar course had been followed by all the Water Companies, with whom they had been acting in perfect harmony; and it had been agreed among them that the general and scientific evidence at their disposal should be deferred until towards the end of the inquiry—a course which had appeared to commend itself to the Commissioners. In connection with this matter, they had sustained a very great loss by the death of their old friend Dr. Tidy, who had made the analysis of the Thames Valley water—of which he had a high opinion—his lifelong study. Acting in concert with the other Companies, they had done their best as regarded the appointment of a successor to Dr. Tidy, so that the general and scientific evidence which they had to offer should be, on behalf of all the Companies, fairly put before the Royal Commission. The Thames Conservancy were now offering their evidence, and other evidence would be brought before the Commission; so that, as he had already said, the inquiry would be a searching one. This was the position at present; and he could only say that they awaited with patience and confidence the issue of the investigation. Pending the inquiry, it might have been supposed that proceedings in Parliament affecting the Water Companies would have been stayed, but that had not been the case. Bills had been promoted both in the House of Lords and the House of Commons. They had thought it inexpedient to oppose these Bills on the second reading; but they had been able to introduce amendments in Committee, which, he might say, would take the sting out of the Bills. The wisdom of this course had been shown. What the aim and scope of the Bill introduced by the London County Council might be, it was very hard for him to say. He should, perhaps, allude to the Bill for introducing a fresh supply of water into Birmingham. It was a very important Bill, and one not uninteresting to themselves. But he would ask this question: If it was to take eight years to bring this water from a distance of 50 or 60 miles—some said 80 miles—to Birmingham [A VOICE: Ten years], what would it cost, and what time would it take, to bring a perfectly new supply into the Metropolis? This was a very important question for the ratepayers to consider. He held in his hand a letter which was written by a ratepayer to *The Times* on, he believed, the 16th of October, dealing with this subject exhaustively. In reference to the market value of their property, it was no business of the Directors to stimulate its price; but it was their duty when—as they saw in the early part of the year—a very rapid fall took place, to calm any alarm, if there seemed to them, at least, no reasonable cause for apprehension. It was true that a very distinguished member of the London County Council, at an early period of the meetings of that body, had rejoiced over the fall in the value of their shares; but he would fain hope that the words in question fell from him hastily, and in the heat of debate, and that he himself would have afterwards regretted if—as might have been the case—a cruel and manifest injustice had been done to those who were obliged at the time to part with their property. The fall in the market value of the shares was not peculiar to their Company—it had extended to the other Water Companies; but he was happy to say that since the speech referred to, all the shares had risen. They might be assured that no Legislature of this country would allow their property to be unfairly depreciated with a view to its acquisition at its so lessened value. Such a principle (or want of principle), if it were to prevail, would amount—he would not use the word "confiscation," because, happily, it was practically unknown to us—but it would be a fatal precedent if introduced under the plea, the false plea, of benefiting the ratepayers. It would begin with water, but did they for a moment suppose it would end there? It would not; it would extend to gas, railway, tramway, dock, and canal property. In fact, it would be a very heavy blow and great discouragement to all shareholders, and would throw a blight over every large industrial undertaking in the United Kingdom.; and it was to be borne in mind that the prosperity and progress of this country so far had been owing mainly to the enterprise of private individuals—by persons associating together under the faith of Acts of Parliament, and not as they saw abroad, where great undertakings were nurtured, fostered, financed, and guaranteed by the aid of states or municipalities. An amount of ignorant prejudice prevailed against the Water Companies, though he could not say why; for they endeavoured to be on good terms with all their customers. On the previous day, he noticed in the streets, on the backs of "sandwich men," a curious exhibition, which would be ridiculous if it were not malicious. Legal proceedings indeed might be taken against the parties; but they did not intend to oblige them, and he would not have alluded to such a contemptible advertisement if it did not lead him to refer to the last report of Dr. Frankland, who said: "The water abstracted from the Thames by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth Companies was, for river water, of a high degree of organic purity, the river being fed during the dry season chiefly by springs in the chalk and oolite. It was efficiently filtered before delivery." That was pretty strong; but beyond that he saw last week in the papers the report on the public health (from which he also proceeded to quote), contrasting the death-rate of London, 17·4 per 1000 with that of Liverpool, 21·9, and Manchester, 24·2. He maintained that, in the face of these documents, no candid person could draw any other inference than this—that the existing supply of water to the Metropolis was not injurious to health. If he had strayed from their immediate business, he would not, at any rate, commit the further error of attempting to forecast the future—not even the immediate future, for events travelled fast; but so long as the Directors were favoured with the confidence of the proprietors, their path was clear. It was to uphold their rights as they had been granted to them by Acts of Parliament, and to maintain their property in such a condition that, if they should, sooner or later, have to hand it over to any other trust, it should be delivered up in good working order. Further, and in the meantime, their effort should be to see that the large and important district committed to their charge was daily and abundantly supplied with good and wholesome water. He concluded by proposing—"That the report of the Directors and the statement of accounts be approved and confirmed, and that the recommendations contained therein be adopted."

Mr. F. TENDRON seconded the motion. They had, he was certain, all listened with the greatest interest to the admirable address of the Chairman; and he most cordially endorsed every word that had been said by him.

Dr. LEESON expressed great satisfaction at the very speedy progress of the Company "all along the line." He felt quite sure that, whatever the demand might be in the future in connection with the water supply of the Metropolis, it could be met by the present Companies; and that, if they could not meet it, no power on earth could, seeing that they possessed the experience and had all the appliances at hand. Those who read political economy would know that masters on the subject had always laid down this principle—that private companies could manage and govern things very much better than could the State; and they had only to go abroad and travel on a railway owned by the State to realize this. As a medical man, he was quite sure that the public could feel that they had a thoroughly good supply of water. He did not say it was cheap, for a good thing could not be obtained cheaply.

The motion was unanimously adopted.

Resolutions were afterwards passed, declaring the dividends recommended, and re-electing the retiring Directors and Auditor; and votes of thanks to the Chairman, Directors, Engineer, Secretary, and staff terminated the proceedings.

CHELSEA WATER-WORKS COMPANY.

The Half-Yearly General Meeting of this Company was held at the Offices, Commercial Road, Pimlico, last Thursday—Sir W. H. WYATT in the chair.

The SECRETARY (Mr. G. H. Gill) read the notice calling the meeting, and the Directors' report was taken as read.

The GOVERNOR, in moving the adoption of the report and statement of accounts, said he thought that they were very satisfactory on the whole. They showed an increase on their gross income for the half year of £1900, which was very gratifying; but, unfortunately, the expenses had also increased. For instance, their rates and taxes were very much larger; and they had had to pay in the half year £623 more under this heading. They also had to incur considerable expense in connection with the monstrous Bills which were periodically brought forward, but which happily did not come to much. With regard to the Bill promoted by the London County Council, the Committee took the same view as the former Committee—that they were not going to empower them to be the Water Authority; and the Bill was simply reduced to an arrangement by which the London County Council might spend a certain sum of money on inquiries. Of course, as ratepayers, they would have to pay a portion of the £10,000 which the County Council were going to expend, and which probably would do no good. It was, however, gratifying to know that they were not going to be considered the Water Authority—a point happily settled. The officers and Directors had also been very much put about in getting the evidence ready for the Royal Commission. He could not say how long the inquiry of the Commission was going on; but they would adjourn almost directly until October. He did not know (and no one else knew) whether they would make a report; but if they did, from what he could see of the Commission, he thought it would be a tolerably fair report. He did not think that the Commissioners would be able to find much fault with the quality of the water; but when they were asked what quantity they would be able to provide 50 years hence, it was difficult to express an opinion. He did not suppose that London would go on increasing in the next 50 years as it had done in the past; but they had plenty of water if their district did increase. They had also had to contend against the action—he would not say of the whole of the members of the London County Council, but of the persistent and malicious effort made by a certain section of that body in trying to depreciate the Water Companies' stocks. It had not succeeded, though it knocked their own stock down to 231; but it very soon regained the greater part of the loss. It was, however, a malicious and vicious thing to do, to support statements which were known not to be accurate. He felt convinced that, if they ever did buy up the undertakings of the Water Companies—he did not believe that it would be for some years yet—it would be found that they would have to pay for them. Parliament would never sanction their property being taken over without a fair equivalent being paid for it. There had been a transaction

to the extent of £700,000 with one of the Lancashire Companies—it was at Accrington—where probably fair terms had been given. That concern had been bought at its statutory dividend of 10 per cent., *plus* 1 per cent. All this showed that the proprietors need not be alarmed by what was occurring. Some people said that they did not care to go into securities which they might have to change in a few years time; and that, of course, affected their stocks. There had been several new supplies laid on in the past half year, as the report informed the shareholders. He was glad to tell them that the Directors had satisfied themselves, not only from the reports of their officers but from personal inspection, that the whole of the works, plant, machinery, buildings, &c., had been, and were being, maintained in efficient order. They had largely increased the constant supply. Since their last meeting they had put on very nearly 4000 houses. Whether this was to do any good for anyone he did not know; but still, the London County Council had the power to demand it, and the Companies were obliged to meet the demand. He did not think that anyone wanted the constant supply in the Company's district. The Superintendent of the district, who had been in the Company's service for the long period of 30 years, had resigned, receiving the proper scale of superannuation. This had enabled them to make fresh arrangements, which he believed (allowing for the superannuation) would not increase their expenses, though not much saving would be effected; but the change would produce much greater efficiency in the working and management, which was the most important object to aim at. They had had some anxiety, as the proprietors could easily imagine, about their coal. They made a very favourable contract for Durham coal; but that, of course, had been suspended. Under the contract, they were to be supplied with Welsh coal if Durham coal could not be furnished them. This had been done, and the Directors were not dissatisfied with the result; but just now they were in a little anxiety again. The contractor said that he would be able to send them Durham coal in a week's time, and he was trying to avoid sending them Welsh coal, which cost him a great deal more; but they had written to him informing him that they might have to buy elsewhere, under the terms of the contract. He had, however, done very well for them up to the present time. It was natural that he should be anxious to put things off for a week or two, so as to save money; but they must not let him go beyond a certain extent in this direction. He might say that, under the advice of the Engineer, they were making experiments at their Molesey works with a view to obtain an auxiliary supply of water from the gravel beds; and he thought that this might produce good results at a moderate cost, and be of advantage to them.

The DEPUTY-GOVERNOR (Mr. F. S. Clayton) seconded the motion, which was unanimously adopted.

Resolutions were afterwards passed authorizing the payment of the dividends mentioned—the distribution on the ordinary stock being at the rate of 10 per cent. per annum for the half year, less income-tax; and re-electing the retiring Directors and Auditor.

The GOVERNOR, in acknowledging a vote of thanks, said it was quite true, as had been said, that the Directors had experienced an anxious time; and he was afraid that that would be the case for some little while yet. All that they could do was their best to protect the interests of the Company; and he had great confidence that those interests would be protected, not only by the Directors, but also by those who were in authority. No one knew what the future would bring forth; but he did not think that their Company would suffer much. There was no fear that they would have any difficulty about their supply of water. They had ample for anything their district could ever require; and in this respect, perhaps, they had not the same anxiety as some of the Companies. They had a district entirely in the County of London; and they knew that there were only 528 acres of it uncovered. Supposing it was covered to the fullest possible extent, they would have an ample supply. He had heard some gentleman ask why the officers were not included in the vote of thanks passed to the Directors. He was sure that the Directors would be very glad if they would pass a separate vote to the officers, who certainly deserved the thanks of the proprietors. They had an excellent staff, all the members of which were anxious to do their very best for the Company; and they spared themselves no trouble or pains to do so. He then proposed a vote of thanks to the officers and staff.

The DEPUTY-GOVERNOR seconded the motion, which was unanimously adopted.

The SECRETARY, in reply, remarked that the officers had had a very anxious time and a time of hard work for some years; but their labours were lightened by the kindness and consideration of the Directors.

The proceedings then terminated.

Crosbie's Paints.—The London County Council have accepted the tender of Mr. Adolphe Crosbie, of Wolverhampton, for the supply of paints, &c., for the next twelve months.

A Burst in the Vyrnwy Aqueduct.—At the meeting of the Liverpool Corporation Water Committee last Tuesday, Mr. G. F. Deacon, the Engineer of the Vyrnwy works, reported that on the night of Thursday the 9th inst., when the water was passing through the main aqueduct and bye-pass pipes at the Mersey into the Prescot reservoir, one of the special pipe castings on Cuerdley Marsh burst. The effect was to wash away a large quantity of the soft earth of the marsh, and to allow a 42-inch valve, weighing about 10 tons, to sink below the level of the pipes. The water could not be stopped in time to prevent a certain portion of it from entering the tunnel. Owing to the nature of the ground, it was not thought safe to relay the disturbed pipes and valve without bedding them on concrete. The broken pipe had been taken out; and it was found that the fracture passed through a hidden flaw about 12 inches in length. Such a flaw could not have been detected beforehand. The whole of the pipes had previously been subjected to the full pressure for a lengthened period, with the exception of a few pipes, including the broken one. This is the second fracture that has occurred between Norton and Prescot, and the third on the whole length of main aqueduct between Oswestry and Prescot—a distance of about 50 miles; and a proportion so small as this is, Mr. Deacon believes, unprecedented.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

When last year the Edinburgh and Leith Gas Commissioners published their accounts, the tale they had to tell was that of a largely increased business, with a debit balance. This year the reverse is the case. Their accounts, which were issued yesterday, show a decreased business, with a large credit balance. Gas sold amounted to 1,221,513,700 cubic feet, a decrease of 27,010,000 cubic feet upon the sale in 1890-91; but the revenue from gas was £270,917, an increase of £41,110. This result was, of course, attained by the increase of 9d. per 1000 cubic feet which was made last year. It was inevitable that there should have been a shrinkage of the consumption, consequent upon such a large increase in price; though, as I have stated already, another reason is given—viz., that, the gas being of better quality, less of it was required. Both reasons probably operated. But whatever causes and effects may be traced in the accounts by ingenious critics, the result is highly satisfactory. The policy of the Commissioners may be criticized, and consumers may grumble at the price they are called on to pay; still the gas is consumed, and that is the best justification the Commissioners could have. If anyone should be bold enough to say that the business of the Gas Commissioners was not in a healthy state, the reply is to refer them to the results of the past two years; and the refutation is complete. In the first of these two years, the Commissioners were harassed by troubles, some of which—such as the rise in the price of coal—were foreseen, but the greater proportion of which—such as the railway strike and the demands of their workmen for higher wages—could not have been anticipated. They were compelled to supply an inferior gas, while charging a high price for it; but the community, though grumbling was rife, consumed their gas to a larger degree than had ever been known before, the consumption rising in that year by nearly 100 million cubic feet. The year just closed has been an uneventful one. So far as outside troubles are concerned, the Commissioners have sailed in smooth waters. Their employees have worked loyally; and the public, though burdened with a heavy price, have not only ceased to grumble, but have contributed to the revenues of the Commissioners for gas a sum of £41,110 more than they did the previous year. This is the most satisfactory feature of the accounts, because the business of the Commissioners is primarily to sell gas; and it is one that points forward as well as backward, and should encourage the Commissioners in their work. In other departments there cannot be the same satisfaction; for unfortunately the markets have not been propitious. Upon coke, for instance, there was a decreased return to the amount of £2750; and upon tar and ammoniacal liquor, of £5281. The total income was £292,212—an increase of £32,958, and the largest which the Commissioners have yet had. Their expenditure was £218,423, an increase of £5611. The coal account amounted to £125,267, which was £12,291 higher than in the previous year. Where the saving was effected was in wages and charges at the works, the repair and maintenance of meters, law and parliamentary expenses, rates and taxes, and pensions. The saving on the last head is due to the death of the late Mr. J. K. Watson, the former Manager of the Edinburgh Gas Company; and I feel confident that the Commissioners are so fully alive to the benefits they derive from Mr. Watson's life-long labours in the promotion of the gas interest in Edinburgh, that they would rather have continued to pay his retiring allowance than have it cut off by his demise. One of the most pleasing features of the accounts is that the Commissioners have, by the issue of mortgages to the amount of £30,000, brought their capital account into something like order. A year ago they were working upon an overdraft to the amount of £21,302. During the year they added £15,419 to their capital expenditure, which left it £36,722 behind the amount raised. There is now only a debit balance of £6722 on the capital account; and that it is to be hoped will soon disappear. They have, after meeting all charges, and contributing £8464 to the sinking fund and reserve fund, a net surplus of £41,497, which they may devote to any purpose they please. It might not be out of place to suggest that they should wipe out this discrepancy in the capital account with it. It is more than likely, however, that, in view of necessary extensions of plant, they will be disposed to carry the whole sum forward. It is to be observed that the accounts do not give the output of gas; and it is consequently impossible to calculate the quantity unaccounted for. That will doubtless be given when the accounts are explained in detail by Bailie Archibald at the July meeting. Meantime, everyone must be pleased to see that the Commissioners have once more engineered themselves into a handsome surplus.

Notwithstanding the expression of disappointment with which Mr. Mitchell, the Finance Convener of the Dundee Gas Commission, introduced the annual accounts of the Commission to the meeting on Wednesday, I do not yet believe the Commissioners have anything to be troubled about in their past year's working. Of course, it must not be forgotten that he was introducing the report of the Finance Committee; and that it was in their department that there was any defect. The deficit in the accounts for the year was £4780, of which £2381 existed at the commencement, leaving £2399 accrued during the year. It is a question how much of this deficit of £2399 arose in consequence of an altered policy of the Commissioners. Two or three years ago it dawned upon the Commissioners that they were drawing uncomfortably near the limit of their capital account; and since then everything has been done which could be done to prevent its increase. That means that more is charged to revenue than used to be. As a matter of fact, £600 was this year paid out of revenue as a one-third instalment of the cost of procuring the Electric Lighting Provisional Order—an expenditure which cannot on any ground be set down as a renewal of gas plant. A similar sum of £600 has this year been charged as one-third of the cost of a retort-bench which it would not have been much of a stretch to charge to capital. Then the Analyst's department cost £324, which is a new charge. There may be other items in the same position; but if these three alone were taken off, the debit balance would thereby be reduced to £857. Mr. Mitchell made

a great deal about the inferior coal, which produced only 9838 cubic feet per ton, instead of 10,000 feet. It is significant to observe that a year ago Mr. Mitchell lamented that, whereas they had contracted for coal to produce 10,200 cubic feet per ton, they had only got 9631 cubic feet; so that last year they had a return of 207 cubic feet more per ton of coal than they did in the previous year. The Commissioners evidently expected less from the coal they contracted for a year ago than they did from the coal they purchased for the year 1890-91, because they estimated that it would produce 200 cubic feet per ton less. It, however, produced 207 cubic feet more; and where the disappointment with it comes in, I cannot see. It appears to me they are inclined to place too much reliance upon the work of their Analyst. It is a well known fact that no coal stands in the works the test of the laboratory; and the Commissioners should allow for that in their estimates. Their idea seems to be that the coalowner should make some allowance—a policy against which nothing can be said, but in favour of which much might be urged, if the gas industry were able to enforce it. Unfortunately, there is no understanding among the owners of gas undertakings on that head; and so long as there is a strong competition for the better qualities of gas coal, it is difficult to see how one body can maintain this position. There is another feature of the accounts which Mr. Mitchell did not refer to—the great increase of unaccounted-for gas. Two years ago it was only 6¾ per cent. Last year it was reported to have risen to 9¼ per cent.; and for the past year it was 10 per cent. This must have affected the revenue largely. I do not consider there is anything out of the way in the loss on this head; because other places show the same result in their accounts this year. The reason is probably to be found in climatic conditions. After all is said, however, the Commissioners have a healthy business; and though their financing of it may be open to some criticism, that is no reason why anyone should express disappointment at the results. They ought rather to be thankful at the magnificent expansion which was experienced in the consumption of gas.

It must be matter of the utmost gratification to all connected with the gas industry that Mr. Whimster, the veteran Manager of the Perth Corporation gas undertaking, should be able to present a record for the past year which can only be characterized as magnificent. The Gas Commissioners had troubles, of their own creating, a few years ago; but they have surmounted them, and are now prosperous. Last year they had an output of 92,231,200 cubic feet of gas—a decrease of 1,600,000 cubic feet—which, considering that the price was last year raised by 6d. per 1000 cubic feet, is highly satisfactory. But better than the output, is the fact that the sale of gas amounted to 85,114,200 cubic feet, which was 658,800 cubic feet more than in 1890-91. This result was attained by a reduction of the leakage from 10 per cent. to 7·23 per cent. Mr. Whimster is exceedingly fortunate in that respect; and the consideration of his good fortune is heightened by the fact that he obtained a yield of 10,540 cubic feet per ton of coal—a return which I have not seen equalled this year, and which shows that Mr. Whimster, with all his years, is still able to give a lesson to many who consider themselves leaders in gas engineering. Possibly the results he has attained are due to the new plant which was put down a couple of years ago; but, there again, he has the credit, for it was he who urged a somewhat stubborn Commission to go in for the renewals and extensions. The revenue for the past year was £18,859, of which £17,316 was derived from gas. The expenditure was £18,163; so that there was a surplus on the year's accounts of £695. Out of this balance, and out of the saving which they expect to make this year upon cheaper coal, they propose to construct two new oxide purifiers at a cost of £650, and to expend £600 in laying new mains. It is proposed to retain the price of gas at 4s. per 1000 cubic feet; and that the gas shall be of 22-candle power. The average price of their coal contracts for this year is 15s. 1d. per ton, which compares very favourably for the Commissioners with the 18s. 6d. per ton which they paid last year, and justifies the expectation that, the existing price of gas being retained, they will make money off it. A motion was made that the price of gas should be reduced by 2d. per 1000 cubic feet, which might have been adopted without loss; but it was not pressed, and in view of the flourishing position of the undertaking, the Commissioners did right, considering that their consumption of gas is still increasing, to endeavour to strengthen their financial position before contemplating a reduction in their revenue.

A deputation of the Edinburgh and Leith Gas Commissioners, including Mr. Mitchell, the Engineer, paid a visit to Paisley last week to inspect Mr. G. R. Hislop's patent process for the recovery of spent lime. The Commissioners were pleased with what they saw; but Mr. Mitchell has still to report upon whether or not it would be advantageous to introduce the process. They use about 4600 tons of lime a year in the Edinburgh works; and the expectation of the deputation is that they might save £2000 a year by the use of the recovery process. Mr. Hislop informed them that it would probably cost £3200 to erect the necessary retorts for the re-burning of the lime. The Commissioners have been put to a great deal of trouble over their waste lime. Some time ago, they acquired land near Penicuik, about 14 miles from the city, and upon it they have laid down several thousand tons of lime. Now the County Council objects that the lime-heap is polluting the water supply of a village in the vicinity; and the Commissioners have been paying the railway company again to bring it back and make use of it in a railway embankment. Even that has now been stopped, on account of the stench; and the Commissioners are at their wits' end what to do with it. Circulars have been sent out to farmers, offering them 6d. per ton to take it away; but, so far, the demand for it has been small.

At the forthcoming annual meeting of the Hawick Gas Company, the Directors will recommend that the price of gas be raised by 7½d. per 1000 cubic feet. Even then it will only be 3s. 11½d. per 1000 feet.

The Brechin Town Council on Monday had before them the subject of the agreement with the Gas Company as to the power of the latter to open the streets for pipe-laying. The agreement is that, in consideration of the Company supplying gas for the public lamps at 4s. 2d. per 1000 cubic feet, they are to be allowed to lay their pipes in the streets free of charge. After some discussion, the Council sent the agreement to a Committee to consider.

The Glasgow Gas Commissioners have again been very successful in the coal market, having obtained contracts for the current year at from 7s. to 8s. 1d. per ton—which is much lower than anything that has been secured by any of the other gas-supplying bodies. One explanation of the very favourable terms which the Commissioners got is the large quantity they take; and another is that the cost of carriage is very small, there being, for the Dawsholm and Temple works, both railway and canal facilities for delivery. The price is a little lower than it was last year.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 18.

Sulphate of Ammonia.—The market is assuming a steadier tone; and there are indications that, at all events for the present, the bottom has been touched. There are now buyers at £9 15s. at the various ports. But few sellers can be found; and £9 16s. 3d. has actually been refused for a parcel for Hull delivery. A firmer market can hardly come as a surprise, when the present reduced production and the deliveries are taken into consideration. Although the demand is by no means large, it is still sufficient for the present ratio of production. Speculative forward business is still taking place on a considerable scale; and it is impossible to explain the *raison d'être* of these sales. There is nothing to warrant a still lower range of prices than that already existing; and it cannot be denied that sulphate has never been so low before. If nitrate has any influence at all upon the sulphate market, it is certainly strange that such risks are being run, seeing that the nitrate market is getting dearer—no doubt in consequence of the news that an agreement has been made among the producers to limit the total imports of 1892 to 17,000,000 quintals, at the same time restricting the January-February (1893) shipments to about 35,000 tons per month, and prohibiting steamer shipments during these two months.

LONDON, *June* 18.

Tar Products.—This market in all positions is in a depressed state. The little spurt in benzols passed away; and to-day they are distinctly weaker than a week ago. The production of benzols, however, has largely decreased during the past month; and it is not likely that prices will go much lower. It is stated, however, that merchants are offering to sell at current rates for twelve months; but makers are not offering beyond the next two or three months. Anthracene is likely to go lower; and sales are reported at less money than lately quoted. There is a little better demand for creosote and salts, but at low prices. Carbolic acid is more sought after; but, so far, value has not improved. An important tar contract over a lengthened period is reported to have been made at a shade above 10s. Pitch is moderately firm; but there are "bear" sellers at less than to-day's quotation. Prices: Tar, 9s. to 11s. Pitch, 28s. Benzol, 90's, 1s. 8d.; 50's, 1s. 4½d. Toluol, 1s. 2½d. Solvent naphtha, 1s. 3d. Crude benzol naphtha, 30 per cent., 8d. Creosote, 1d. Naphthalene salts, 20s.; pressed, 45s. Carbolic acid, crude, 60's, 1s. 1d.; 70's, 1s. 4d.; crystals, 5d. Cresol, 8d. Anthracene, 30 per cent., "A" quality, 10d.; "B" quality, 7d.

Sulphate of Ammonia.—There is more business being done; but the price does not improve. The only encouragement that can be extracted from the position of the market is that prices have remained fairly steady for the last two or three months. There is a better feeling in the market; but it is too much to expect that, at this season of the year, the price will seriously advance. Considerable sales have been made at prices varying from £9 12s. 6d. to £9 15s., less 3½ per cent. Gas liquor (10 oz.) is nominally quoted from 5s. to 6s.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is no very new feature to notice in the coal trade of this district, beyond what I reported last week. The holiday stoppages of the pits have for the time checked the putting down of stocks, and the accumulation of any large surplus supplies upon the market. But the demand has been extremely quiet for all descriptions of round coal; and although quoted prices are nominally unchanged, the tendency continues decidedly in favour of buyers. The better qualities of round coal are necessarily only in very restricted request for house-fire purposes, and concessions are here and there made to effect sales; but quotations remain on the basis of about 12s. for best Wigan Arley, 10s. to 10s. 6d. for Pemberton four feet and second qualities of Arley, and 8s. 6d. to 9s. for common house-fire coals, at the pit mouth. The chief difficulty which colliery proprietors are experiencing is, however, with the lower qualities of round coal, which are becoming a drug in the market, owing to the unsatisfactory condition of the principal coal-using industries; and prices show a decided downward tendency. At the pit mouth, the average quotations are not more than 7s. 9d. to 8s. 3d. per ton for good qualities of steam and forge coal; but under these figures is often taken, and buyers would have no difficulty in placing orders at about 7s. 6d. per ton for ordinary descriptions of steam coal. For shipment, even lower prices are being quoted; and although there have been smaller supplies offering at the ports on the Mersey, common steam coal has been quoted at 8s. 9d. to 9s. per ton delivered at the Garston Docks or the High Level, Liverpool. For the better qualities, some of the colliery proprietors are still holding to 9s. 3d. and 9s. 6d. per ton. As regards gas-making coals, there has been little or nothing doing towards the settling of contracts during the holidays; but, so far as there is anything to report, prices seem to be generally well maintained at close upon the basis of those obtained last year. I do not hear of concessions of more than about 3d. per ton being quoted; although, in some very exceptional cases, I believe 6d. under last year's prices has been taken. Some further inquiries for locomotive fuel are coming upon the market. But, as I reported last week, there seems to be a growing determination on the part of the leading colliery firms not to entertain the low prices which were accepted recently for one or two contracts placed with the L. and N. W. Railway Company; and it seems more than doubtful

whether the further contracts which are to be given out will be placed, except at some more satisfactory prices to the colliery proprietors. For engine classes of fuel, there has been a generally good demand; and prices are well maintained at late rates, with a hardening tendency in some instances where low figures were being quoted. At the pit mouth, good qualities of burgy are firm at 6s. 3d. to 6s. 9d.; the better qualities of slack, 4s. 9d. to 5s. 3d.; and common sorts, 3s. 3d. to 3s. 9d.

Northern Coal Trade.—The coal trade of the North is now settling down to steady work; and prices are generally easier. Best Northumbrian steam coal is quiet at about 10s. 6d. per ton f.o.b.; but small steam coal has fallen more in proportion, and may now be had at 4s. 9d. per ton—or half the maximum price in the strike. Durham coals are lower; though the fall is rather unequal. Best gas coal has been sold at from 8s. to 9s. 6d. per ton f.o.b.; and the price depends much on the position and the extent of the contracts of the various collieries. In one or two cases, the pits have still to supply the coal that should have been sent out in the strike time; and thus such collieries have very little coal to sell. But in one or two instances, the buyers of the coal have got alternative supplies in the time of the strike; and they have decided not to take the quantity that the northern pits would have furnished. The latter have therefore fair amounts of free coal; and thus the pits ask rather unequal prices. Bunker coals are weaker at from 8s. to 8s. 6d. for unscreened; and the manufacturing coals are also a little lower in price. Household coals are rather dull; and most of the landsale collieries have lowered the prices. There is a good demand for smithy coals. Coke is now in rather larger supply; and from 17s. to 17s. 6d. per ton is the general price for best Durham makes. Gas coke is dull; but the production is only very limited just now.

Scotch Coal Trade.—Main coal has been selling freely this week; but other varieties remain unchanged. As for some weeks past, all business done has been for prompt delivery. Buyers are holding back to see what effect the re-starting of the Durham pits will have on the market. The demand for foreign gas-works has now ceased, which should have a lowering effect upon that for home gas undertakings. The prices quoted are: Main, 7s. 9d.; ell, 8s. 6d. to 8s. 9d.; splint, 8s. 3d. to 8s. 6d.; and steam, 10s. to 10s. 3d. per ton. Shipments still continue to be very heavy. The latest returns show 159,371 tons, an increase of 18,825 tons over the corresponding week of last year; and for the year to date, 3,196,381 tons, an increase of 425,610 tons.

Gas Exhibition at Middlesbrough.—From Tuesday to Friday last week, the Davis Gas-Stove Company, Limited, held an exhibition of gas appliances in the crypt of the Town Hall, Middlesbrough. Miss Ida Cameron delivered free lectures on cooking by gas twice daily.

Electric Lighting in Oxford.—Last Saturday evening the principal streets of Oxford were lighted by electricity; the current being switched on by the Mayor (Mr. F. W. Ansell), after an invitation dinner given by the Oxford Electric Lighting Company at the generating station, under the presidency of the Chairman (Mr. J. Irving Courtenay). The lamps, which are of 3000-candle power each, are situated near the railway station, on Carfax, in High Street, Broad Street, and Magdalen Street, and the work has been carried out by the Electric Construction Corporation, of Wolverhampton, for the Company, of which Mr. George Offor is General Manager and Secretary.

The Neepsend (Sheffield) Gas-Works Ambulance Class.—The members of this class held their annual meeting last Wednesday, when, in the presence of a large gathering, a very enjoyable programme of music and recitation was gone through. Mr. Allan, the Manager of the works, presided; and, referring to the report of the Examiner (Dr. Cassidi, of Derby), complimented the members on their efficiency—all having succeeded in passing. He also heartily congratulated Dr. Pearson, who had so ably instructed the class. During the evening, the certificates were presented to the members by Mrs. Allan; and, on behalf of the class, Mr. Allan presented Dr. Pearson with a handsome silver inkstand, which he suitably acknowledged.

The Purchase of the Accrington Gas and Water Works by the Corporation.—On Monday last week the Accrington Town Council decided, subject to certain safeguards, to purchase the undertaking of the Accrington Gas and Water Company. The Company supply gas and water to four local board districts, as well as to Accrington. The terms agreed upon are the payment of perpetual annuities amounting to £23,474, which is equal to the maximum statutory dividend, *plus* 10 per cent., with an additional £9000 for compensation to officers and costs. It was stated that the Company's net profits amount to upwards of £24,000 a year; and that for years they have paid the statutory dividends, and left handsome surpluses from which bonuses and back dividends have been paid, new offices built, and the plant kept in excellent order. At 30 years' purchase, the sum agreed upon is upwards of £700,000; and it was stated that, assuming Parliament will grant time for the repayment of the sinking fund, it is hoped the transfer can be effected without being any burden on the rates.

Bradford Corporation Water Department.—In moving, at the meeting of the Bradford Town Council last Tuesday, a resolution for the adoption of the annual estimates and the laying of a general district rate, Alderman John Hill, the Chairman of the Finance Committee, gave a few statistics showing the financial position of the Water Department. He said that the receipts during the past year had been—for water-rents and meter supply, £114,315; for rents of property and other items, £3828—making together, £118,143. The payments had been as follows: For interest and sinking fund, £100,101; wages of workmen, £5211; salaries, £2537; rents, &c., £973; rates and taxes, £6326; repairs and paving, £3109; soak and goit, £184; Gilstead filters, £820; Heaton pumping-station, £624; waste-water department, £1218; and sundry items, £1347—making a total of £122,454, and showing a deficit of £4311. This deficiency was caused partly by a falling-off in the receipts for water by meter, but chiefly by extra outlays, such as cleaning out Chellow reservoir and other works. The Water Committee and the Finance Committee had decided that this loss should be met from a reserve fund of over £17,000 still existing to the credit of the Water Department.

The Kirkleatham Water-Works Arbitration.—The Stockton and Middlesbrough Water Board have decided to appeal against the decision of the Divisional Court, as given in the JOURNAL for the 7th inst. (p. 1067), confirming the alternative award of the Arbitrator in the Kirkleatham case, and reducing the amount from £25,424 to £8006.

Gas Affairs at Leeds.—At last Thursday's meeting of the Leeds Corporation Gas Committee, the salaries of Mr. Tooley, Manager of the Meadow Lane works, and of Mr. Smith, Manager of the New Wortley works, were increased by £50 each. The Committee also accepted a tender amounting to £2414 for the construction of an overhead railway at the Meadow Lane station, and another for the necessary brick work, amounting to £1072.

Assault on a Gas Company's Servant.—At the Wandsworth Police Court last Friday, Arthur Jones, a butcher, of 2, The Terrace, West Hill, was summoned for assaulting Albert Attwell, a servant in the employ of the Wandsworth and Putney Gas Company. Mr. Besley said the defendant was indebted to the Company in a sum of £12; and as applications for payment had been of no avail, the complainant was sent to cut off the gas. While doing so, the defendant committed the assault complained of. Mr. Denman said men must be protected in the discharge of their duties; and he fined the defendant 20s.

Extensions of Gas Plant.—Among other plant which Messrs. Clapham Bros., of Keighley, are now carrying out, are six large purifiers for the Douglas (Isle of Man) Gas Company, and a similar number for the Sheffield Gas Company; three "Eclipse" washer-scrubbers (Laycock and Clapham's patent)—one for Penrith, one of 2 millions per day for Stockport, and one of similar size for Dewsbury. Fittings for 550 retorts for the Manchester Corporation, and for 60 retorts for the Ilkley Gas Company are in hand; and the firm will shortly commence the erection of a patent condenser to pass 3 millions per day for the Burnley Corporation.

East Surrey Water Company.—The report of the Directors of this Company, which was presented at the annual general meeting of shareholders last Saturday, stated that there was a balance of £2579 on the 25th of March last; and they recommended that dividends of 5 per cent. on the preference shares, and 4 per cent. on the ordinary shares, should be declared. These (less the interim dividends) would amount to £2239, and leave £340 to be carried forward. The business of the Company continues to increase; an accession of 261 consumers having taken place during the past year. The works, under the Manager and Secretary (Mr. J. R. Downes) have been extended; and the new pumping-station at Kenley will shortly be in regular use.

The Gas War in Cleveland (Ohio).—The contest over the price of gas which has been going on for a year in Cleveland (Ohio) has now, says the *Engineering Record*, ended by a compromise which includes not only the lowering of the price of gas by the two Companies, but a readjustment of their relations to the Municipality. A year ago the Council passed an ordinance reducing the price of gas from $1 to 60 c. per 1000 cubic feet. The Companies declared the order equivalent to a confiscation of their property; and they carried the matter to the United States Circuit Court. The hearing had progressed to the presentation of testimony for the city, when a compromise was agreed upon, whereby the Companies accept a rate of 80 c. per 1000 cubic feet for a term of ten years, and also agree to pay into the city treasury 6½ per cent. of the gross receipts for gas, and bear the expenses of litigation. This is a much more sensible outcome than to waste capital by building competing works, which would ultimately have been absorbed and paid for in some way.

Abolition of Differential Prices at Walsall.—An important discussion took place at the meeting of the Walsall Town Council on Monday last week, on a recommendation of the Gas Committee to abolish, as from the 1st prox., the existing differential charges for gas, and make the price a uniform one of 2s. 6d. per 1000 cubic feet to all classes of consumers. To this an amendment was brought forward, to adjourn the discussion until a table had been prepared giving the number of consumers at the present rates of 2s. 4d., 2s. 6d., and 2s. 8d. per 1000 cubic feet, and showing the difference the proposed uniform rate would make on the consumption of the past year. After some debate, the amendment was rejected by a large majority. Another was then submitted to make the price 2s. 4d. per 1000 cubic feet. But the Town Clerk pointed out that, if it was carried, it could not come into effect until next year, as the estimates had been made out, and the average profits of the gas undertaking calculated thereon; and on being put to the vote, it was rejected. A further amendment, to make the price 2s. 5d., met with a similar fate, though the majority against it was smaller than in the other cases. The original proposition was then put and carried.

Annual Report of the Coventry Corporation Gas Committee.—The annual report of the Gas Committee of the Coventry Corporation for the year ending March 25 last states that, after providing £1381 the year's payment into the sinking fund, there is a net profit of £309 available for the general district fund in relief of rates, as against £2015 in the previous year, and £2560 the year before. There has been an increase in the sale of gas amounting to nearly 34 million cubic feet, as compared with the preceding year, or rather more than 12 per cent. The receipts, however, have not risen in proportion to the increase in the amount of gas sold, owing to the reduction of 1d. per 1000 cubic feet made in June last; while, on the other side of the account, there is a further rise in the price of coal, as well as the increase in wages granted in May, 1891. The market for residuals also has not been so good as formerly. These causes together account for the serious reduction in the net profits. The Committee mention that they have taken advantage of the flourishing state of trade during the last few years to rebuild the oldest of the retort-houses, which was in a dangerous condition. This has been done at a cost of £2684, which has been provided out of revenue, and has been spread over the last three years. In renewing the retorts in that house, they have been built on the inclined principle; and it is anticipated that this will effect a saving in the cost of labour to the extent of about £1000 a year.

Completion of New Works for the Cirencester Gas Company.—The old works of the Cirencester Gas Company, erected in 1833, have lately been replaced by new ones, which have been put up under the superintendence of Mr. E. M. Beecham, the Company's Manager. They have been constructed from the plans of Mr. Thos. Newbigging, M.Inst.C.E., of Manchester; and they are admirably adapted to meet the requirements of the Company's business. The retort-house is 70 feet by 62 feet, with an adjacent coal-store, 70 feet by 30 feet, next the railway, and an engine and boiler house 36 feet by 25 feet. The bulk of the plant has been supplied by Messrs. R. and J. Dempster, of Newton Heath, Manchester. There are three gasholders, of 100,000, 60,000, and 25,000 cubic feet respectively. The engine and exhauster were supplied by Messrs. George Waller and Co. The capacity of the new works is about 50 million cubic feet per annum, as compared with 30 millions, the productive power of the old ones.

Damages Under the Employers' Liability Act.—At the Westminster County Court, on Monday last week, Mr. F. Bayley and a jury had before them the case of *Parrish v. The Gaslight and Coke Company*, in which the plaintiff sought to recover damages for injuries sustained in the Company's service. He was at work in the coal-store at the Haggerston Station, filling coal-buckets, which were hauled up through the roof; and while so engaged, a large plank, as he averred, fell from the roof and struck him on the head. For the defence, a foreman in the Company's employ was called, and swore positively that there was no plank which could have fallen upon the plaintiff; and, moreover, the roof had not been uncovered at the part where he alleged that the plank had dropped through. Pieces of coal, he said, often lodged on the cross beams of the building; and it was the duty of the men to push them down. He saw the plaintiff shortly after the accident, and he appeared to be a little dazed; but he was certainly not insensible. A number of other witnesses, including the medical men who attended the plaintiff, were also called. The jury found that there was a defect in the defendants' works or machinery; and they awarded the plaintiff £10 damages, but did not attach any blame to the foreman. The judge entered a verdict accordingly, with costs.

The Stoke Corporation Gas Department.—At the meeting of the Stoke Town Council last Thursday, Alderman Leason announced that for the year ended March 31 last, the gross profits of the gas undertaking had been £5954, and after paying all the extra charges of the year, there was left a net profit of £2577 for the reduction of the rates. The Gas Committee recommended, and it was agreed, that, at the special request of Mr. Lass, the following letter from Messrs. Alfred Lass, Wood, and Co., bearing upon matter which transpired at the previous meeting (*ante*, p. 1028), should be entered on the minutes: "The figures in our report with reference to the sinking fund are perfectly correct. They are based upon the figures settled by the Board of Trade in the Stoke Provisional Order, 1888; and we cannot go behind that Order. The figures in Mr. Sant's table differ from those in the Provisional Order to the extent of £1600, which constitutes the whole difference between Mr. Sant's figures and ours. You will also observe that we have given credit to the sinking fund for the full amount of the repayments shown in the published accounts of the Committee for the year ended March 31, 1891—viz., £4217. We have not the books to refer to at this moment; but as far as our memory serves us, we think you will find that the £1600 was paid off very shortly after it had been borrowed, and the Board of Trade no doubt took that into consideration when they settled the figure given in the Provisional Order as £41,900, instead of Mr. Sant's figure of £43,500. If it is desired that the £41,900 mentioned in the Provisional Order of 1888 should be altered for the purpose of making it agree with Mr. Sant's table, it appears to us that application will have to be made for another Provisional Order." The Gas Committee also recommended that £1000 should be handed to the Town Council towards the reduction of the rates; and this was agreed to.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1182.)

Issue.	Share	When ex-Dividend.	Dividend on Last Issue.	NAME	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Apr.	10½	Alliance & Dublin 10 p. c.	10	16¾—17¼	..	6 0 0
100,000	10	,,	7½	Do. 7 p. c	10	11—12	..	6 5 0
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 5
100,000	20	27 May	8	Bahia, Limited	20	10—12	..	13 6 8
200,000	5	12 May	7½	Bombay, Limited	5	6¼—6⅝	..	5 11 1
40,000	5	,,	7½	Do. New	4	4⅛—5	..	6 0 0
380,000	Stck.	26 Feb.	12½	Brentford Consolidated	100	212—217	..	5 12 11
150,000	,,	,,	9½	Do. New	100	164—168	+1½	5 10 1
220,000	20	11 Mar.	11½	Brighton & Hove Original	20	40—42	..	5 9 6
888,500	Stck.	11 Mar.	5	Bristol	100	95—100	..	5 0 0
320,000	20	13 Apr.	11½	British	20	42—44	..	5 2 3
50,000	10	26 Feb.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
31,510	10	,,	8½	Do. 7 p. c.	10	15—16	..	5 6 3
328,750	10	—	—	Buenos Ayres (New) Limited	10	6¾—7⅛	..	—
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	94—97	..	6 3 9
150,000	20	26 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	13 Apr.	13	Commercial, Old Stock	100	229—234	..	5 11 1
165,000	,,	,,	10	Do. New do.	100	180—185	..	5 8 1
130,000	,,	15 June	4½	Do. 4½ p. c. Deb. do.	100	117—120*	..	3 15 0
800,000	Stck.	15 June	13	Continental Union, Limited	100	218—223*	+3	5 16 7
200,000	,,	,,	10	Do. 7 p. c. Pref.	100	185—195*	+1	5 2 7
75,000	Stck.	30 Mar.	10	Crystal Palace District	100	185—195	..	5 2 7
486,090	10	29 Jan.	10	European, Limited	10	19—20	..	5 0 0
354,060	10	,,	10	Do. Partly paid	7½	14—15	+½	5 0 0
5,470,820	Stck.	12 Feb.	12	Gaslight & Coke, A, Ordinary	100	207—212	—½	5 13 2
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	94—98	..	4 1 7
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	250—255	..	3 18 5
30,000	,,	,,	5	Do. F, 5 p. c. Pri.	100	118—123	..	4 1 3
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	169—174	..	4 6 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	154—158	..	4 8 7
463,000	,,	,,	10	Do. J, 10 p. c. Pri.	100	247—252	..	3 19 5
476,000	,,	,,	—	Do. K, 6 p. c. Prf.	100	148—153	..	3 18 5
1,061,150	,,	15 June	4	Do. 4 p. c. Deb. Stk.	100	114—116*	+1½	3 9 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	118—121*	+1½	3 14 4
908,000	,,	,,	6	Do. 6 p. c. do	100	163—166*	+½	3 12 3
3,800,000	Stck.	12 May	12	Imperial Continental	100	210—214	—1	5 12 1
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	4—4¼	..	6 13 4
560,000	100	1 Apr.	5	Met. of Melbourne, 5p. c. Deb.	100	108—110	..	4 10 11
541,920	20	15 June	5	Monte Video, Limited	20	14—15*	..	6 13 4
150,000	5	27 May	10	Oriental, Limited	5	7⅛—8¼	..	6 1 2
60,000	5	30 Mar.	7	Ottoman, Limited	5	4—5	..	7 0 0
166,870	10	26 Feb.	2	Pará Limited	10	2—3	..	—
420,000	100	3 May	6	People's Gas of Chicago— 1st Mtg. Bds.	100	106—110	..	5 9 1
500,000	100	1 June	6	and Do.	100	100—103	..	5 16 7
150,000	10	15 Oct.	10	San Paulo, Limited	10	8—9	..	—
500,000	Stck.	26 Feb.	15½	South Metropolitan, A Stock	100	265—270	..	5 14 10
1,350,000	,,	,,	12	Do. B do.	100	215—220	—1½	5 9 1
200,000	,,	,,	13	Do. C do.	100	230—240	..	5 8 4
725,000	,,	30 Dec.	5	Do. 5 p. c. Deb. Stk.	100	142—146	..	3 8 6
60,000	Stck.	11 Mar.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
729,331	Stck.	30 Dec.	10	Chelsea, Ordinary	100	253—258	+1	3 17 6
1,720,252	Stck.	13 Apr.	8	East London, Ordinary	100	195—200	..	4 0 0
544,449	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	138—142	..	3 3 4
700,000	50	11 Dec.	8½†	Grand Junction	50	99—103	..	4 2 6
708,000	Stck.	12 Feb.	10½	Kent	100	260—265	..	3 19 3
1,043,800	100	30 Dec.	9½	Lambeth, 10 p. c. max.	100	224—228	+2	4 3 4
406,200	100	,,	7½	Do. 7½ p. c. max.	100	190—195	+2	3 16 11
279,700	Stck.	30 Mar.	4	Do. 4 p. c. Deb. Stk.	100	121—124	..	3 4 6
500,000	100	12 Feb.	12½	New River, New Shares	100	325—335	..	3 22 4
1,000,000	Stck.	29 Jan.	4	Do. 4 p. c. Deb. Stk	100	127—130	+1	3 1 6
902,300	Stck.	15 June	6½	S'thwk & V'xhall, 10 p. c. max.	100	147—152*	+2½	4 5 6
126,500	100	,,	6½	Do. D 7½ p. c. do.	100	134—138*	+3½	4 14 3
1,155,066	Stck.	15 June	10	West Middlesex	100	237—242*	..	4 2 8

*Ex div.

† Next dividend will be at this rate.

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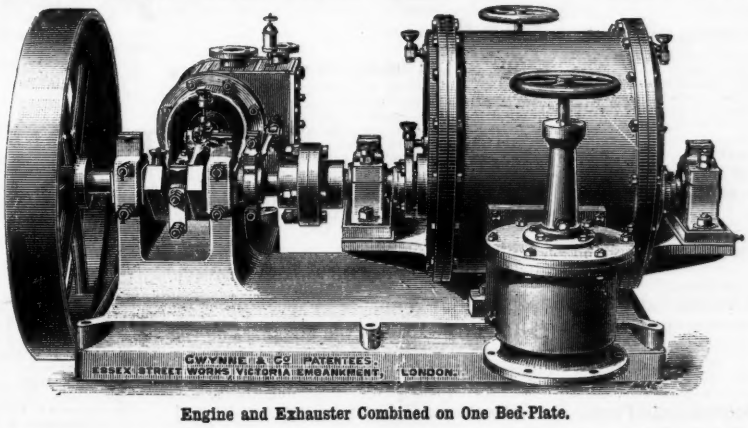

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Send price per ton to ALFRED GANN & Co., 2, Fowkes Buildings, Great Tower Street, LONDON.

HIGH WYCOMBE GAS-WORKS.

FOR SALE—A Second-hand Gasholder, 35 ft. by 14 ft., capacity 14,000 cubic feet, in good condition. Also second-hand 2-horse power "OTTO" GAS-ENGINE, very little used. Prices moderate. Can be seen by appointment.
F. W. THURLOW,
Manager.

BRUSH SCRUBBER.

FOR SALE—A Brush Scrubber, to pass 350,000 cubic feet per 24 hours, in good order. Being removed to make room for apparatus of greater capacity.
Apply to the MANAGER, Gas-Works, KIRKCALDY.
Kirkcaldy, N.B.,
June 7, 1892.

PONTYMISTER GAS-WORKS.

FOR SALE—Ten Ω-shaped Mouth- pieces, 17 in. by 18½ in., with Lugs, Cross-Bars, and T-Screws, Ten 4-inch ASCENSION-PIPES, and Ten 4-inch H-PIPES; also Two lengths of 14-inch diameter HYDRAULIC MAIN, each length 8 ft. 8 in., with Ten 4-inch Dip-Pipes fitted complete.
Prices to be sent to
W. D. JONES,
Manager.
June 2, 1892.

GAS PLANT FOR SALE.

THE Directors of the South Normanton, Blackwell, and Hucknall-under-Huthwaite Gas Company have FOR SALE the following GAS PLANT, viz.:—
Hydraulic Main, suitable for six Retorts.
Annular Condenser, with 4-inch Connections.
Scrubber, 9 ft. high by 4 ft. 6 in. diameter.
Two Purifiers, 4 ft. 6 in. square, complete, with Centre-Valve and Connections.
One Station Meter.
Gasholder, 30 ft. diameter by 10 ft. deep, complete with two Hydraulic Valves.
Governor, with 4-inch Bye-Pass.
For further particulars, apply to
A. FORRETT,
Manager.

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

GASHOLDER AND CONDENSERS FOR SALE.

THE Great Yarmouth Gas Company have FOR DISPOSAL a GASHOLDER, with Cast-Iron Tank complete; also a set of CONDENSERS in good condition.

Further particulars can be obtained on application to the Engineer.

HYDE GAS COMPANY.

COAL AND CANNEL—TAR AND LIQUOR.

THE Directors of the Hyde Gas Company invite TENDERS for COAL and CANNEL. Also OFFERS for TAR and LIQUOR for One year, ending the 30th of June, 1893.

Particulars may be obtained from the undersigned, at the Gas-Works, Raglan Street, Hyde.

WILLIAM SMITH,
Secretary and Manager.

June 10, 1892.

THE Haworth Local Board of Health are prepared to receive TENDERS for the supply of 1700 tons of unscreened GAS COAL, to be delivered (in such quantities as the Board may determine) on Rails at the Haworth Railway Station within the ensuing Twelve months.

Tenders to be forwarded to me the undersigned, marked "Coal Tender," on or before the 23rd inst.

WM. ROBERTSHAW,
Clerk.

5, Temple Street, Keighley,
June 11, 1892.

NEWARK GAS COMPANY.

TO MANUFACTURING CHEMISTS AND OTHERS

THE Directors of the above Company are prepared to receive TENDERS for the purchase of the AMMONIACAL LIQUOR produced at their Works for One year from the 1st day of July, 1892, at per degree Twaddel (temperature 60° Fahr.).

The Liquor to be no less than 5° in strength.

Terms, Cash monthly.

Further particulars can be had on application to the undersigned, to whom sealed tenders, marked on the outside "Tender for Liquor," are to be sent in on or before the 28th inst.

The highest tender will not necessarily be accepted.

By order,
FREDK. B. FOOTTIT,
Secretary.

Newark, June 13, 1892.

STAINES AND EGHAM DISTRICT GAS AND COKE COMPANY, LIMITED.

THE Directors of this Company invite TENDERS for the supply and delivery, during the year 1892-93, of 6000 tons of either EAST PONTOP, PELAW MAIN, or HOLMSIDE GAS COALS.

The deliveries to commence after the 1st of November next, and continue during the period ending on the 30th of September following.

The Company's Works are on the Bank of the Thames.

Forms of Tender, giving quantities, may be obtained upon application to the Secretary; and all further information may be obtained from the Manager, Mr. Thomas Webb, at the Works, Egham.

Sealed tenders to be sent to the undersigned on or before the 5th day of July, 1892.

JOHN ANTHONY ENGALL,
Solicitor and Secretary.

Staines, June 9, 1892.

SHIPLEY GASLIGHT COMPANY.

TENDERS FOR COAL.

THE Directors of the Shipley Gaslight Company invite TENDERS for the supply of about 15,000 tons of screened GAS COAL, to be delivered free at the Midland or Great Northern Railway Stations, Shipley, or at the Gas-Works, per Leeds and Liverpool Canal, over a period of Twelve months from July 1, 1892.

The Directors reserve to themselves the right to divide the quantity into two or more contracts, and do not bind themselves to accept the lowest or any tender.

Tenders, sealed, and endorsed "Tender for Coal," are to be sent to me on or before Friday, the 24th of June.

JNO. WILCOCK,
Manager.

Gas-Works, Shipley, Yorks.,
June 10, 1892.

CHELMSFORD GASLIGHT AND COKE COMPANY.

TENDERS FOR COAL.

THE Directors of the above Company invite TENDERS for the supply of GAS COAL for One year, commencing Aug. 1, 1892.

The quantity required is about 3500 tons.

The Coal must be fresh, of the best quality, well screened, free from Bats, Stones, Dust, Pyrites, and all other Impurities.

Sealed Tenders, stating price per ton, delivered free at the Siding of the Great Eastern Railway Company, Chelmsford, or f.o.b. the Company's Ships in the Tyne, endorsed "Tender for Coal," must be sent not later than the 27th of June next.

The Directors reserve to themselves the right to decline the lowest or any tender.

Particulars of monthly deliveries, and any further information, may be had of the undersigned on application.

EDMUND G. SMITHARD,
Engineer.

Gas-Works, Chelmsford,
June 7, 1892.

BOROUGH OF WARRINGTON.
(GAS DEPARTMENT.)

TO COLLIERY PROPRIETORS.

TENDERS are invited for the supply of 17,000 tons of COAL, and 2000 tons of CANNEL.

Further particulars can be obtained on application to Mr. W. S. Haddock, Engineer to the Department.

Sealed tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Gas Committee, must be sent in not later than Twelve a.m. on the 30th inst.

FREDK. TAYLOR,
Secretary.

Gas Offices, Warrington,
June 10, 1892.

NORTHWICH GAS COMPANY.

TENDERS are invited for the supply and delivery at Northwich Railway Station, of about 9000 tons of GAS COAL during the ensuing Twelve months.

Tenders are also required for the supply and delivery of LIME and SULPHURIC ACID during the same period.

Any further particulars required may be had on application to Mr. Mellor, Manager.

Tenders, endorsed and addressed to the Chairman, must be delivered here not later than Ten a.m. on Saturday, June 25.

HY. PICKERING,
Secretary.

Gas-Works, Northwich,
June 10, 1892.

BOROUGH OF NELSON.
(GAS DEPARTMENT.)

THE Gas Committee of the above Corporation invite TENDERS for the supply of about 76 tons of 6, 4, and 3 inch CAST-IRON PIPES (with Turned and Bored Joints).

Specification and Form of Tender can be obtained from the Engineer, Mr. Wm. Foster.

Tenders to be endorsed "Tender for Pipes," and addressed to Mr. R. Prescott, Town Hall, Nelson, and sent in on or before Wednesday, the 29th day of June, 1892.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
R. M. PRESCOTT,
Town Clerk.

Town Hall, Nelson,
June 10, 1892.

TO GASHOLDER MAKERS.

THE Altrincham Gas Company invite TENDERS for the construction and erection of a GASHOLDER.

The Drawings and Specification may be seen at the Gas Offices, Altrincham, on application to the Manager, Mr. J. E. Lamb, and at the Office of Mr. Thomas Newbigging, C.E., 5, Norfolk Street, Manchester.

Copies of the Bill of Quantities and Form of Tender may be obtained from the latter on deposit of two guineas, which will be returned on receipt of a *bond fide* tender.

Sealed tenders, endorsed "Gasholder, Contract No. 2," to be addressed to me, and sent so as to reach me not later than Twelve o'clock Noon on Tuesday, the 12th day of July next.

The Directors do not bind themselves to accept the lowest or any tender.

F. R. B. LINDSELL,
Secretary.

Gas Offices, Altrincham,
June 16, 1892.

CROMER, NORFOLK.

TENDERS FOR COAL.

THE Directors of the Cromer Gas and Coke Company, Limited, are prepared to receive TENDERS, from Colliery Proprietors only, for the supply of 800 tons of first-class GAS COAL, to be delivered at (*a*) the Great Eastern Railway Station, or (*b*) the Eastern and Midlands Railway Station, Cromer, between the 1st day of July next, and the 31st day of May, 1893. Weight given to be stated.

Deliveries to be made in such quantities and at such times as may be required by the Company.

Payment, net cash monthly.

Sealed tenders, endorsed "Tender for Coal," to be sent to the undersigned, on or before Monday, the 4th of July next.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
P. E. HANSELL,
Secretary.

Cromer, June 17, 1892.

CROMER, NORFOLK.

TO CONTRACTORS AND ENGINEERS.

THE Directors of the Cromer Gas and Coke Company, Limited, are prepared to receive TENDERS for the following Works:—

CONTRACT No. 1.—The Construction of a BRICK GASHOLDER TANK, TAR TANK, &c.

CONTRACT No. 2.—The Erection of a GASHOLDER and GUIDE-FRAMING, SCRUBBER, PURIFIER and CONNECTIONS, &c.

Plans and Specifications as to both Contracts can be seen at the Office of the Engineer, Mr. Jabez Church, M Inst.C.E., 55, Parliament Street, Westminster, S.W., and as to Contract No. 1 at my Office, Cromer, between the hours of Ten a.m. and Four p.m.

A limited number of Copies of the Bills of Quantities for Contract No. 1 have been printed, and can be obtained on application to the Engineer.

Persons can tender for one or both Contracts; but tenders must be sent in separately for each.

Tenders, on the form provided for the purpose, and properly endorsed, must be sent to me on or before Monday, July 4, 1892.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
P. E. HANSELL,
Secretary.

Cromer, June 18, 1892.

THE Directors of the Ware Gaslight and Coal and Coke Company, Limited, invite TENDERS for the supply of from 900 to 1200 tons of EAST PONTOP, NEW PELTON, or PELAW MAIN GAS COALS, to be considered at their Meeting to be held on Tuesday, the 21st of June inst.

Full particulars may be obtained on application to me the undersigned at my Office.

Dated this 7th day of June, 1892.

By order of the Board,
GEO. H. GISBY,
Secretary to the Company.

Baldock Street, Ware.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TO TAR DISTILLERS.

THE Directors of this Company invite TENDERS for the purchase of 700 tons of the surplus TAR now in stock, and to be produced at their Works in Radcliffe during the ensuing year.

Particulars may be obtained from the undersigned, to whom endorsed tenders must be delivered not later than Thursday, the 30th inst.

JAMES BRADDOCK,
Manager and Secretary.

Gas-Works, Radcliffe,
June 7, 1892.

CIRENCESTER GAS COMPANY, LIMITED.

THE Directors are prepared to receive TENDERS for the supply of from 2000 to 3000 tons of best screened GAS COAL, to be delivered during the Twelve months ending the 30th of June, 1893, at the Watermoor Station of the M. & S. W. Junction Railway Company, at such times and in such quantities as the Manager may direct.

Tenders, marked "Tender for Coal," to be sent to the undersigned not later than Thursday, the 30th of June, 1892.

The Directors do not bind themselves to accept the lowest or any tender.

J. P. BEECHAM,
Secretary.

12, Silver Street, Cirencester,
June 11, 1892.

TO IRONFOUNDERS, ETC.

THE Directors of the Sheffield United Gaslight Company invite TENDERS for the supply of RETORT-FITTINGS, including Hydraulic Mains, Ascension-Pipes, Buckstaves, &c., for 96 Mouthpieces at their Effingham Street Station.

Form of Tender, with Bill of Quantities, may be obtained, and Drawings can be seen, on application to the Engineer, Mr. Fletcher W. Stevenson, on and after Saturday, the 18th inst.; and sealed tenders must be delivered, addressed to the undersigned, not later than Saturday, July 2, endorsed "Tender for Retort-Fittings."

The Directors do not bind themselves to accept the lowest or any tender.

HANBURY THOMAS,
General Manager.

June 11, 1892.

SOWERBY BRIDGE LOCAL BOARD OF HEALTH.
(GAS DEPARTMENT.)

THE Gas Committee of the Sowerby Bridge Local Board are prepared to receive TENDERS for the supply of 10,000 tons of best GAS COAL and 1000 tons of CANNEL COAL required in each year, for One, Two, or Three years, from July 1, 1892.

Specifications and Form of Tender can be obtained by applying to the Manager at the Gas-Works.

Tenders to be sent in not later than Monday, June 27, 1892, endorsed "Tender for Coal" or "Cannel," and addressed to the Chairman of the Gas Committee, Gas-Works, Sowerby Bridge.

The Gas Committee do not bind themselves to accept the lowest or any tender.

JOHN MARSLAND,
Engineer and Manager.

Gas-Works, Sowerby Bridge,
June 10, 1892.

TENDERS FOR GASHOLDER.

THE Directors of the Rochester, Chatham, and Strood Gaslight Company invite TENDERS for the Construction and Erection of a TELESCOPIC GASHOLDER, with a Wrought-Iron GUIDE-FRAMING.

Plans can be seen, and Copies of Specification had, after the 27th of June, on application at the Offices of the Company, 58, High Street, Rochester.

Tenders, marked "Tender for Gasholder," to be delivered at the Offices as above before Noon of Thursday, the 28th of July, 1892.

The Directors will not be bound to accept the lowest or any tender.

WILLIAM SYMS, Secretary.

June 16, 1892.

SUTTON, SOUTHCOATES, AND DRYPOOL GAS COMPANY, HULL.

INVITE Tenders for the surplus Tar, also for the whole of the AMMONIACAL LIQUOR produced at their Works at per ton over the Company's Machine, from the 1st of July, 1892, to the 30th of June, 1893, both inclusive.

Probable quantity of Tar, 700 tons.
Do. Ammoniacal Liquor, 900 tons.

Both Tar and Ammoniacal Liquor to be taken from the Company's elevated Tank into Contractor's Carts or Casks, which must be supplied as required by the Vendors.

Tenders for Ammoniacal Liquor must state price per degree Twaddel's Hydrometer, from 4° to 8°.

Further particulars may be obtained of the Manager at the Gas-Works, St. Mark's Street.

Tenders to be sent to the undersigned, on or before the 24th of June, 1892, endorsed "Tender for Tar or Liquor."

The Company do not bind themselves to accept the highest or any tender.

DAVID WOOD,
Secretary.

Offices: St. Mark's Street, Hull,
June 10, 1892.

The Subscription List will open on Wednesday, the 22nd of June, and close on Tuesday, the 28th of June, 1892.

The Automatic Gas-Meter COMPANY, LIMITED.

CAPITAL - - £50,000,

IN 10,000 £5 ORDINARY SHARES.

Present Issue, £20,000, in 4000 Shares of £5 each.

Payable 10s. per Share on Application, £1 on Allotment, and the balance in calls as required, not exceeding 10s. per Share each month.

DIRECTORS.

FRANCIS FLEMING, Esq., Chairman of Directors, Messrs. Fleming, Birkley, and Goodall, Limited, Halifax.
Mr. Councillor WALTER BATTLE, Westfield, Leeds, Newspaper Proprietor.
JAS. RILEY ATKINSON, Esq., Spring Bank, Sowerby Bridge, Manufacturer.
JOHN GREENALL, Victoria Park, Manchester, Gas-Stove Manufacturer.
JOHN HAYNES, Esq., Manager, Liverpool Gas-Fittings Company, Gas Office, Liverpool; late Superintendent, Corporation Gas-Fittings Department, Birmingham.

BANKERS.

THE MANCHESTER AND LIVERPOOL DISTRICT BANKING COMPANY, LIMITED, King Street Branch, Manchester.

SECRETARY (*pro tem.*).
MR. T. G. MARSH.

TEMPORARY OFFICES.

41, CORPORATION STREET, MANCHESTER.

ABRIDGED PROSPECTUS.

This Company has been formed for the purposes of purchasing and working the valuable English patents of Mr. Thomas Thorp and Mr. Thomas Gardiner Marsh, and also of Mr. John Haynes, and also of Messrs. Thomas Thorp, Thomas Gardiner Marsh, and John Haynes, relating to Patent Automatic Attachments for application to ordinary Gas-Meters for the purpose of enabling the consumer to obtain gas in small quantities by the prepayment of a coin.

The first Letters Patent bears date 1st May, 1889. The others are Provisional Protections, one dated 7th August, 1891, the other dated 9th January, 1892, and full patents are being applied for.

Agreements have been entered into with the several patentees for the purchase of their several interests in such patents for the sum of £10,000—viz., £5000 in cash, and £5000 in fully paid-up Shares in the Company, or in cash, at the option of the Directors.

The Vendors have worked the several patents for a sufficient time to prove their thorough usefulness, and have succeeded in introducing them to the favourable notice of the authorities supplying gas in some of the very largest towns in England; the object of the Company being to make and sell to Corporations and Gas Companies the meter and attachments for use by those in whose hands the supply of gas is vested.

Very favourable terms have been made with Mr. T. G. Marsh, one of the Inventors and Vendors, to superintend and manage the business of the Company, for a period of five years, at a rate of remuneration varying with the profits of the concern—thus insuring his best energy and attention; and an agreement embodying these terms has been entered into with him.

In the city of Liverpool alone, upwards of 1000 of these meters and attachments have been used by the Liverpool Gas Company, and are giving every satisfaction.

The main object and intention is to enable Gas Companies to profitably undertake the supply of gas to the artizan and labouring classes, which are to be found in all districts. It is pretty well known that Gas Companies have been reluctant to deal with these classes on the ordinary credit system, as on the one hand the smaller consumers decline to take supply of gas from those Companies where deposits are demanded, and other restrictions put upon them. They have, therefore, been compelled to use oil for the supply of light.

The idea of the present invention is to enable each of the smaller consumers to obtain a supply of gas immediately, either for lighting or cooking purposes, by the insertion of a penny or pennies into an aperture attached to the meter, which gives to each consumer the exactly proportionate supply of gas by reference to the price charged in the particular town; while, on the other hand, it assures to the Company and their servants freedom from any possibility of loss by placing the money so paid in a position of security until the meter is visited, and the amount of the payments is collected from the boxes in the ordinary way.

Certain agreements have been entered into, which are fully set out in the Prospectus, and can be seen, and all other information obtained, on inquiry at the Office of the Company's Solicitors.

PONTYPOOL AND GAS WATER COMPANY.

CONSTRUCTION OF NEW WORKS, ETC.

AUTHORIZED CAPITAL	£100,000
ISSUED AND FULLY PAID-UP CAPITAL—	
A Shares and Stock	£28,400
B Shares	10,000
4 per cent. Debentures	7,500
	£43,900

Issue of 1500 New "C" Shares of £10 each, to rank equally with the Ordinary "B" Shares of the Company, and *pari passu* (according to the respective Maximum Dividends) with the Ordinary "A" Shares and Stock—payable £1 per Share on application, and the balance on the 31st of August, 1892.

DIRECTORS.

CHARLES JAMES PARKES, Esq., J.P., Wentaland, Pontypool (*Chairman*).
EDWIN GROVE, Esq., J.P., Newport, Mon., Chairman Monmouthshire County Council (*Vice-Chairman*).
ALFRED ADDAMS WILLIAMS, Esq., J.P., Maesderwen, near Pontypool.
FREDERICK PHILLIPS, Esq, Green Lawn, near Pontypool.
THOMAS HEDGES DEAKIN, Esq., Parkend, Gloucestershire.
WILLIAM HENRY DAVIES, Esq., Glansychan, near Pontypool.

MANAGER.

LIEUT.-COL. ANDREW HAIR, Trosnant House, Pontypool.

SECRETARY and OFFICES.

T. B. PEARSON, Trosnant, Pontypool.

TENDERS are invited for the purchase of the above in Lots of 10 Shares; but Applicants may Tender for any number of Lots.

The Shares are sold pursuant to the powers conferred on the Company by and subject to the provisions of the Pontypool Gas and Water Act, 1890, and the Acts incorporated therewith; and all Tenders will be deemed to be subject thereto, and to the terms herein contained.

The Maximum Dividend on the "A" Stock and shares is 10 per cent., and on the "B" (and "C" Shares now created) 7 per cent.; and, in case of any insufficiency in the net revenue to yield such percentages, a proportionate reduction will be made in the Dividend on each class of Shares.

The Company have paid 7½ per cent., free of Income-Tax, on the "A" Shares since 1874, and 5 per cent., free of Income-Tax, on the "B" Shares since the same were created in 1876.

The Shares will rank for Dividend as from the 1st day of September, 1892, provided the full purchase-money is paid as herein required.

Should no allotment be made, the deposit will be returned in full.

Forms of Tender may be obtained on application to the undersigned.

Sealed tenders, endorsed "Tender for Shares," to be sent to me not later than Friday, the 8th day of July, 1892.

By order,
T. B. PEARSON,
Secretary.

Trosnant, Pontypool,
June 7, 1892.

CORPORATION OF MOSSLEY.

(GAS DEPARTMENT.)

THE Gas Committee are prepared to receive TENDERS for the supply of 7000 tons of COAL and 1000 tons of CANNEL.

Sealed tenders to be sent to the Town Clerk, endorsed "Gas Coal," not later than Noon on the 11th of July.

Particulars and Form of Tender may be obtained on application to the Manager (Mr. Richard Merrell).

The Committee do not bind themselves to accept the lowest or any tender.

By order,
JOSEPH HYDE,
Town Clerk.

Mossley, June 11, 1892.

COUNTY BOROUGH OF SALFORD.

(GAS DEPARTMENT.)

TENDERS FOR GENERAL STORES.

THE Gas Committee of the Corporation are prepared to receive TENDERS for the following MATERIALS, in such quantities as may be required during the Twelve months following the acceptance of Tenders, viz.—

1. Iron.
2. Tin Sheets, &c.
3. Lead and Composition Pipes, Glass, Pig Lead &c.
4. Bolts, Nuts, Rivets, &c.
5. Iron Castings.
6. Brass Meter Taps and Keys.
7. Steam Tubing and Fittings.
8. Gas-Meters.
9. Paints, &c.
10. Chandlery.
11. Oils, &c.
12. Cotton Waste.
13. India-rubber Sheetings, Rings, &c.
14. Portland and Roman Cement.
15. Timber.
16. Rope and Yarn.
17. Haulage.
18. Horse Provender.
19. Veterinary Attendance.
20. Brushes and Besoms.
21. Steel Shovels.
22. Lime.

Forms of Tender and all further Information may be obtained on application to the Engineer, Gas Offices, Bloom Street, Salford.

Sealed tenders, endorsed "Tender for Miscellaneous Goods," together with samples of goods offered, addressed to the Chairman of the Gas Committee, Town Hall, Salford, must be delivered to me not later than Five p.m., on Thursday, the 7th of July next.

By order,
SAML. BROWN, Town Clerk.

Town Hall, Salford,
June 16, 1892.

HULL GASLIGHT COMPANY.

TENDERS FOR TAR.

THE Kingston-upon-Hull Gaslight Company invite TENDERS for the surplus TAR for One year, the same to be sent in to the Chairman of the Company on or before the 27th of June, 1892.

Particulars may be obtained from
THOMAS BULL,
Engineer and Manager.

Gas-Works, Broadley Street, Hull.

TENDERS FOR GAS COAL.

THE Directors of the Cheltenham Gas light and Coke Company are prepared to receive TENDERS for the supply of GAS COAL for One year from the 1st day of August next.

Particulars may be obtained from the undersigned, to whom tenders must be delivered on or before Wednesday, the 22nd of June next.

The Directors do not bind themselves to accept the lowest or any tender.

R. O. PATERSON,
Engineer.

Gas-Works, Cheltenham,
June 10, 1892.

CITY OF CARLISLE.

TAR CONTRACT.

THE Carlisle Gas Committee are prepared to receive TENDERS for the Surplus TAR to be produced at their Works, for a period of One or more years from the 30th of June next.

Any further particulars required can be obtained upon application to the Engineer, to whom sealed tenders, endorsed "Tender for Tar," must be delivered on or before July 5, 1892.

The Committee do not bind themselves to accept the highest or any tender.

J. HEPWORTH,
Engineer.

Gas-Works, Carlisle,
June 8, 1892.

CITY OF CARLISLE.

TENDERS FOR COAL AND CANNEL.

THE Carlisle Gas Committee are prepared to receive TENDERS for the supply of about 16,000 tons of screened or unscreened GAS COAL, and about 4000 tons of CANNEL, to be delivered at their Works in Carlisle in such quantities as may be directed, from July, 1892, to June, 1893.

Tenders, specifying the description of the Coal or Cannel, the pits at which they are raised, and the terms for the net monthly payment, are to be sent on or before July 5, 1892, endorsed "Tender for Coal."

J. HEPWORTH,
Engineer and Manager.

Gas-Works, Carlisle,
June 8, 1892.

CITY OF HEREFORD.

THE Gas Management Committee of the Corporation invite TENDERS for the supply of best screened large GAS COAL for One year, from the 1st of August next, to be delivered free at the Gas-Works Siding, Hereford, in such quantities as may be required from time to time.

The estimated quantity required will be from 7000 to 8000 tons.

Full Particulars and printed Forms of Tender may be obtained on application to the undersigned.

Tenders, endorsed "Tender for Gas Coal," are to be sent in, addressed to the Chairman, Gas Management Committee, Mansion House, Hereford, by Saturday, July 2

The Committee do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM PARLBY,
Gas Engineer and Manager.

Gas-Works, Hereford,
June 9, 1892.

CITY OF HEREFORD.

TO TAR DISTILLERS AND OTHERS.

THE Gas Management Committee of the Corporation invite TENDERS for the surplus TAR produced at their Works for a term of One year from the 1st of July next.

Particulars and printed Form of Tender may be obtained on application to the undersigned.

Tenders, endorsed "Tender for Tar," are to be sent in, addressed to the Chairman of the Gas Management Committee, Mansion House, Hereford, by Saturday, July 2.

The Committee do not bind themselves to accept the highest or any tender.

By order,
WILLIAM PARLBY,
Gas Engineer and Manager.

Gas-Works, Hereford,
June 9, 1892.

TENDERS FOR SCREENED GAS COAL.

THE Directors of the Tamworth Gaslight and Coke Company invite TENDERS from Colliery-Owners, for the supply of 2000 tons of good screened GAS COAL, at per ton of 21 cwt., delivered free at either the London and North-Western Railway, or Midland Stations, at such times, and in such quantities, as may be required.

The contract to commence as from the 1st day of July, 1892, and continue until July 1, 1893.

Tenders, with name of Colliery, Analysis of Coal proposed to be supplied, and endorsed "Tender for Gas Coal," to be sent to me on or before July 1 next (on printed forms, which may be had on application to me).

The Directors do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM ARNOLD,
Secretary.

23, George Street, Tamworth,
June 9 1892.

TENDERS FOR GAS COAL.

THE Directors of the Bishop's Stortford Gas Company, Limited, invite TENDERS for the supply of 2500 tons of screened GAS COAL, to be delivered free into the Store at the Gas-Works, during a period of Twelve months from Aug. 1, 1892.

Particulars and Form of Tender can be obtained on application to the Company's Manager, Mr. J. W. Portass.

The Directors reserve to themselves the right to divide the quantity into two or more contracts, and will not guarantee to accept the lowest or any tender.

No tender will be considered, except on the Company's printed form.

Tenders, sealed and endorsed "Tender for Coal," are to be sent to me on or before Monday, the 11th of July, 1892.

W. GEE,
Secretary.

TIPTON GAS-WORKS.

TAR CONTRACT.

THE Gas Committee of the Tipton Local Board invite TENDERS for the purchase of the surplus TAR produced at the above Works, during a period of One, Two, or Three years, from the 1st of July next.

Particulars may be obtained at the Gas-Works, on application to Mr. Vincent Hughes, the Engineer and Manager.

The Tar may be delivered either into Boats or on Rail (L. & N.W.R.), as may be required.

Sealed and endorsed tenders to be sent to me the undersigned not later than Ten a.m., on Friday the 24th inst.

The Committee do not bind themselves to accept the highest or any tender.

By order,
GEO. M. WARING,
Clerk to the Board.

Public Offices, Tipton,
June 9, 1892.

TO COAL MERCHANTS.

THE Sittingbourne Local Board invite TENDERS for the supply of about 450 tons of best inland small COAL (similar to a sample to be seen in the Board's Store at the Water-Works, Keycol Hill, Sittingbourne, to be delivered into the said Store during the ensuing Twelve months, in such quantities as may be required, free of all charges.

Payment will be made for the weight of Coal delivered only upon the quantity being certified by the Proprietors of the Weigh-bridge at the Tannery, Chalkwell, Milton, whose charges shall be paid by the Contractor.

Tenders to be sent to the undersigned not later than Noon on Tuesday, the 28th of June.

The Board do not bind themselves to accept the lowest or any tender.

W. J. HARRIS,
Clerk to the Board.

Sittingbourne,
June 16, 1892.

CORPORATION OF DONCASTER.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for the supply of GAS COALS, screened or unscreened (about 18,000 tons per annum), for One, Two, or Three years.

Particulars and Form of Tender can be obtained on application to the Chairman or Engineer.

Tenders, addressed to Alderman Athron, Chairman, endorsed "Tender for Gas Coals," to be delivered at this Office not later than Saturday, the 25th inst.

The Committee do not bind themselves to accept the lowest or any tender.

R. BRIDGE,
Engineer and Manager.

Gas-Works, Doncaster,
June 10, 1892.

TO GAS COAL OWNERS AND DEALERS.

THE Directors of the Paignton Gaslight, Coke, and Coal Company, Limited, are prepared to receive TENDERS for the supply of about 2500 tons of GAS COAL, to be delivered free at Paignton Railway Station, in such quantities as the Directors may determine within the ensuing Twelve months.

Tenders, endorsed "Tender," accompanied by working analysis as to quantity and quality of the Gas and Coke produced, to be sent addressed to me the undersigned on or before Thursday, the 30th inst., before Six o'clock on that day.

The lowest or any tender will not necessarily be accepted.

F. W. PUDDICOMBE,
Secretary.

Manor Office, Paignton, Devon.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of 20,000 tons of GAS COAL for One year, from the 1st day of August next, in such monthly quantities as may be required by the Company.

Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or, if sent (as preferred) by Water, the price delivered both in Vessel and at the Gas Company's Wharf, on the Gloucester and Berkeley Canal.

Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than Monday, the 11th day of July next.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
June 9, 1892.

OSWALDTWISTLE LOCAL BOARD.

THE Gas Committee invite Tenders for the TAR and LIQUOR produced at their Works for One year from the 31st day of July, 1892.

The quantity of Coal carbonized is over 3500 tons.

Further particulars may be obtained from the Manager, Gas-Works, Church, near Accrington.

Endorsed tenders to be addressed to me and to be delivered not later than Wednesday, the 13th of July.

WM. SANDEMAN,
Clerk.

Local Board Offices, Oswaldtwistle,
June 17, 1892.

TENDERS FOR GAS COAL.

THE Directors of the Westerham Gas and Coke Company, Limited, invite TENDERS for a Year's supply of about 500 tons of the best screened GAS COALS, delivered at Westerham Station, in quantities to suit the convenience of the Directors.

Tenders, stating the description, and endorsed "Tender for Coals," to be sent to the Office of the Company on or before Wednesday, the 6th of July.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
CHARLES HOOKER,
Secretary and Manager.

Westerham, Kent.

GAS COAL.

TENDERS are invited for the supply of from 2000 to 6000 tons of good GAS COALS, capable of yielding, under average working, 10,500 cubic feet of 15-candle Gas per ton of 20 cwt., and Coke of good quality.

Deliveries to be made in such quantities as may be required during Twelve months from July next.

Quotations to specify if coal is screened or unscreened.

Offers may be sent to me, endorsed "Tender for Gas Coal," during the next Ten days.

FRED. G. DEXTER.
Manager.

Water and Gas Company, Winchester,
June 14, 1892.

CORPORATION OF LONGTON.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for their surplus TAR for the year ending June 30, 1893.

Estimated quantity, about 600 tons.

Tenders to state price per ton for the Tar, which will be delivered into the Contractor's Railway Tanks at Longton Station by the Corporation.

Tenders, properly endorsed, and addressed to the Chairman of the Gas Committee, Gas-Works, Longton, must be delivered on or before Tuesday, the 28th inst.

W. W. HULSE,
Secretary and Manager.

June 10, 1892.

GASHOLDERS

C. & W. WALKER

Are now erecting a four-lift Holder of about 8 MILLION cubic feet,

at the Beckton Gas-Works, London.

PURIFIERS;

PURIFYING MACHINES;

CO_2 AND TAR-EXTRACTING WASHERS; SCRUBBERS;

SULPHATE & SULPHUR PLANT;

PATENT SELF-SEALING RETORT MOUTHPIECES;

LIFTING APPARATUS; CENTRE AND FOUR-WAY VALVES;

SOLE MANUFACTURERS OF WECK'S PATENT CENTRE-VALVE;

PATENT TAR PLANT; CONDENSERS;

SLIDE VALVES; TAR BURNERS; &C., &C.

WOOD SIEVES.

ADDRESSES:

MIDLAND IRON-WORKS, DONNINGTON, NEAR NEWPORT, SHROPSHIRE;

10, Finsbury Square, London.

"FORTRESS DONNINGTON." "FORTRESS LONDON."—Telegraphic.

TO COAL CONTRACTORS AND OTHERS.

THE Sedgley Local Board invite Tenders for supplying 500 to 1000 tons of GAS COAL, the deliveries to be made at Shut End Siding, at such times and in such quantities as may be directed.

Sealed tenders, marked "Coal," to reach me on or before the 8th of July next.

The Board do not bind themselves to accept the lowest or any tender.

By order,
JOSEPH SMITH.
Clerk.

Offices: High Holborn, Sedgley,
June 16, 1892.

THE Directors of the Brentwood Gas-light and Coke Company invite TENDERS for 2000 tons of good screened GAS COALS, delivered, as required, at their Works, Brentwood, Essex.

The Contract to commence from the 3rd of July next, and continue to the 1st of April, 1893.

Tenders, stating price per ton, and information as to the quality and quantity of Gas the Coal is estimated to produce, to be sent to the undersigned, not later than the 1st of July.

The Company do not bind themselves to accept the lowest or any tender.

C. A. FIELDER,
Secretary.

FAREHAM GAS AND COKE COMPANY.

THE Directors invite Tenders for the supply of 1200 to 1400 tons (more or less) of best fresh wrought GAS COAL, delivered by Water and metered free into Carts at their Wharf at the Works, in such quantities as they shall from time to time require during the year ending June 30, 1893.

Quarterly settlements.

Tenders, specifying description and the pits from which the Coal is to be supplied, to be sent in to me by the 27th inst.

The lowest or any tender not necessarily accepted.

HARRY SMITH,
Secretary.

Gas-Works, Fareham, Hants,
June 21, 1892.

THOMAS'S JOINTLESS GAS GAUGES.
COWES, I.W.

AUG. KLÖNNE,
DORTMUND (GERMANY).

REGENERATIVE FURNACES.

Unsurpassed in
Efficiency, Economy, Durability, and Easy Working.

HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production nearly 3000 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16¼ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves 69 per cent. of excellent Coke. During the year 1890, the London Gas Companies carbonized about 400,000 tons of HOLMSIDE COALS. They are used by The Gaslight and Coke Company, the South Metropolitan Gas Company, the Commercial Gas Company, the Woolwich (Government) Gas-Works, the Newcastle and Gateshead Gas Company, the European Gas Company, the Ipswich Gas Company, and by many other Gas Companies both at Home and Abroad.

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-ON-TYNE.

T. B. KITTEL, SHEFFIELD.
CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL
ENGLISH & SCOTCH CANNELS.
REAL SILKSTONE GAS COAL
ANALYSIS AND PRICES ON APPLICATION.
T. B. KITTEL, SHEFFIELD.

UNEQUALLED.
Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

MEIKLEJOHN'S PATENT
Improved Slide-Valve Anti-Dip.

Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip combined.
Is cheap and easily fixed to any form of main.
Will be found the most efficient appliance of the kind yet introduced.
Further particulars and price from

C. MEIKLEJOHN,
OLDBURY, BIRMINGHAM.
(Late N. MEIKLEJOHN, Longwood.

Lanemark Coal Co.,
LIMITED.

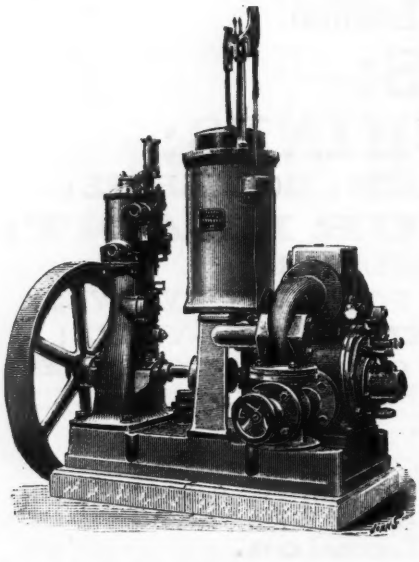
LANEMARK CANNEL AND GAS COALS.

Quotations and Analysis on application to

LANEMARK COLLIERY,
NEW CUMNOCK, N.B.

Shipping Ports: All the principal Scotch Ports.

CAN BE SEEN IN ACTION ON AND AFTER JUNE 13.
(AT ADDRESS BELOW)



WALLER'S PATENT COMBINED GAS ENGINE AND EXHAUSTER
WITH
Disc-Valves, Automatic Bye-Pass Valve, Throttle-Valve, and Regulator,
COMPLETE ON ONE BASE PLATE.
Designed chiefly for sizes from 500 to 15,000 feet per hour.

EXHAUSTERS OF ANY SIZE
COMBINED WITH GAS-ENGINES (now made to vary in speed).

ENGINES & EXHAUSTERS RUN AT DIFFERENT SPEEDS.
Waller's Washer-Scrubber with Wood Clusters.
ELEVATING AND CONVEYING MACHINERY FOR COAL, COKE, &c.

G. WALLER & CO.,
58, PARK STREET, SOUTHWARK (SURREY SIDE OF SOUTHWARK BRIDGE).

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

THOMAS ILLINGWORTH,
NORTH DEAN CHEMICAL WORKS,
Near HALIFAX,
MANUFACTURER OF SULPHURIC ACID
OF EXTRA QUALITY FOR MAKING
WHITE SULPHATE OF AMMONIA.

TAR, LIQUOR, AND SPENT OXIDE Purchased for Cash against Delivery.

ROSEWELL BOGHEAD.

Yield of Gas per ton . . . 13,215 Cub. Ft.
Illuminating Power . . . 37·56 Candles.

GAVIN PAUL & SONS,
CANNEL COALMASTERS,
EDINBURGH.

For **FIRE-BRICKS,** the most durable for **GAS-FURNACES,**
ADDRESS
JAMES WHITE & Co., Limited,
ALBERT WORKS, WIDNES.

THOMAS TURTON AND SONS, LIMITED,
Sheaf & Spring Works,
SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES, SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

MARKS & RUSSELL,
Cannel and Gas Coal Merchants,
53, WATERLOO STREET,
GLASGOW.

CAST-IRON PIPES
FOR GAS AND WATER.
Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.
VALVES
FOR GAS, WATER, AND STEAM.
TELEGRAMS: "PIPES GLASGOW."
WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

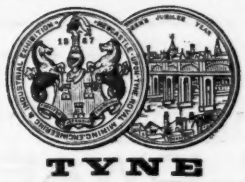
JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."
These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY
Strongly recommended where EXCESSIVE HEATS have to be maintained.

ROBERT MARSHALL,
CANNEL COAL MERCHANT
97, WELLINGTON STREET, GLASGOW.
Prices and Analysis of all the Scotch Cannels on application.

COKE BREAKERS,
PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT.)
New Design, with two Cutting Rollers, making less Breeze than their old pattern.
GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.

NEWBATTLE CANNEL.
QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.
Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.



TYNE BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

For Prices and complete Analysis, apply to
YOUNG, DANCE, & CO.,
COAL OWNERS, NEWCASTLE-ON-TYNE.
Or E. FOSTER & CO., 21, John St., Adelphi, LONDON, W.C.

PREPAYMENT GAS-METER.
(PRICE'S PATENT.)

This Meter has a simple Automatic arrangement fitted, whereby, upon the insertion of a shilling, a supply of gas can be obtained, and which is cut off on the quantity paid for being consumed. The Meter gives warning when the quantity is nearly exhausted, so that another shilling may be inserted. There is, however, no occasion to wait until this happens, as a second shilling can be inserted after two-pennyworth of the first shilling has been consumed.

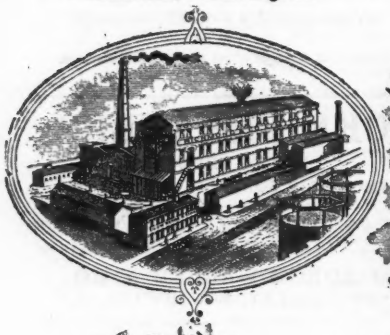
The Meter is fitted with the ordinary registering dial, and has in addition a circular one divided showing twelve pence. On each Meter is marked the number of cubic feet it will pass for one shilling; and this can be arranged to cover cost of Meter-Rental, Fitting, and Gas consumed. These Meters are made of the best material and workmanship.

SPECIALLY ADAPTED FOR INCREASING CONSUMPTION AMONGST SMALL CONSUMERS.
NO RISK OF BAD DEBTS.

PROPRIETORS AND MANUFACTURERS:
D. HULETT & Co., LIMITED,
GAS-METER MAKERS, 55 & 56, HIGH HOLBORN, LONDON.

Telegrams:
"Gastoves," Warrington.

LONDON OFFICES & SHOW-ROOMS: 93, CHEAPSIDE (Corner of King Street), E.C.
Winners Nelson Test June 2, 1891; Nottingham Medal, Nov. 28, 1891.



GAS COOKING RANGES
Richmond & Co Limited
GAS FIRES
Heating Stoves
WATER HEATERS
BOILING BURNERS
GAS ENGINEERS

WARRINGTON & LONDON.

E. W. T. Richmond, Managing Director. **Sole Agents for Webb's Lamps.**

No. 120.

THE "MODEL" RANGE.

Acknowledged to be the Best and Cheapest Cooker in the Market.

WITH WHITE ENAMELLED CROWN PLATE. *RICHMOND'S PATENT.*	No. 30.	No. 40.	No. 50.	No. 100.	No. 120.	No. 140.	No. 160.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
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JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

THE MOST RELIABLE STANDARD OF LIGHT

IS

HARCOURT'S

STANDARD

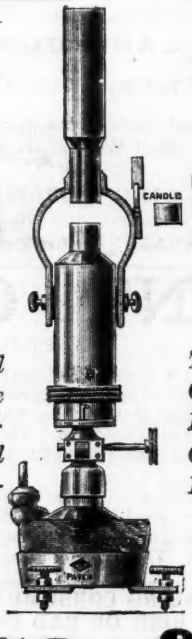
"PENTANE" LAMP.

No. 2.—Improved Type,

AS USED BY

Mr. Dibdin, Mr. Heisch, Liverpool United Gas Company, The Hague Gas-Works, The Leyden Gas-Works, Alex. Wright & Co., Stafford Corporation Gas-Works, Negretti and Zambra, Mr. Frank Livesey, Mr. Jas. Swinburne, Winfields Limited, &c., &c.

Prices, &c., from



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HARCOURT'S

STANDARD

"PENTANE" LAMP.

No. 2.—Improved Type,

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The Admiralty, the United States Government, Chinese Government, Cie. Parisienne du Gaz, Dublin University, Harvard University, Owen's College, Manchester, Lord Rosse, Mr. W. H. Preece, Imperial Technical Institute, Berlin, &c., &c.

Prices, &c., from

Woodhouse & Rawson

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88, QUEEN VICTORIA STREET, LONDON, E.C.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S PATENTS

All Spent Limes are most effectually, economically, and continuously recovered, and at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it. Descriptive Pamphlet and Terms from Agents as under.

— REGENERATIVE SETTINGS OF RETORTS. —

Hislop's Patent Producer and Patent Charging Appliances offer advantages which are unapproachable; while in every other detail his Settings are confidently recommended as being the most inexpensive and effective possible.

Illustrated Pamphlet and Terms on application to J. E. FISHER, Stourbridge, Agent for England and Wales; to C. M. HAMILTON, Portland Place, Hamilton, Agent for Scotland and Ireland; and for all other Countries to the Patentee,

Geo. R. HISLOP, Gas Engineer, PAISLEY, N.B.

WILLEY & Co.,

Gas Engineering Works, Commercial Road, Exeter.

MANUFACTURERS OF EVERY DESCRIPTION OF

GAS APPARATUS,

GASHOLDERS, Telescope and Single-Lift, any size. Some of the largest in the Kingdom erected by this Firm are giving the highest satisfaction.

PLANS and SPECIFICATIONS furnished for **Extensions** and **Enlargement** of existing **Works,** adapting them to the most **Improved** and **Modern Principle** of **Gas Manufacture.**

PURIFIERS, CONDENSERS, WASHERS, ENGINES and EXHAUSTERS, STATION METERS and GOVERNORS, manufactured and erected.

Makers, by permission of that eminent authority **Mr. GEORGE LIVESEY,** of his **CELEBRATED PATENT WASHER,** highly approved by all the Engineers of Works where adopted. Largely in demand.

Special reference and attention are invited to our

WET AND DRY METERS,

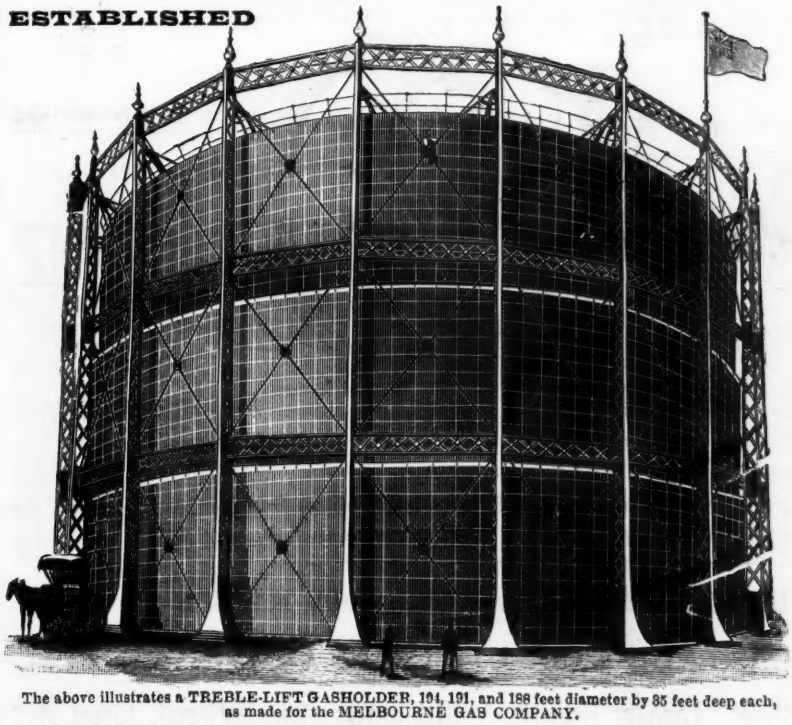
which have acquired a high reputation for the **excellence** of Materials and Workmanship; their **durability** and **accuracy** of **Register** guaranteed. They are used by several of the **London Gas Companies,** and over **200 Provincial Gas Companies.**

Price Lists, Specifications, and Estimates provided for any work appertaining to Gas Lighting, from the Retort-House to the Drawing-Room.

R. DEMPSTER & SONS, Ltd.,

ROSE MOUNT GAS ENGINEERING WORKS,

ESTABLISHED **1855.**



The above illustrates a TREBLE-LIFT GASHOLDER, 194, 191, and 188 feet diameter by 85 feet deep each, as made for the MELBOURNE GAS COMPANY.

RETORT-FITTINGS,
CONDENSERS,
EXHAUSTERS,
PURIFIERS,
SULPHATE PLANTS,

AND EVERY DESCRIPTION OF

Gas and Chemical Plant.

ELLAND.

The Gasholder sheets are levelled by machinery, and are afterwards sheared, squared, and punched by an Improved Combined Multiple Punch and Shearing Machine, which also punches the circumferential seams of crown sheets by special punches and dies, ensuring perfect accuracy, avoiding rimering in erection.

JOHN HALL & CO.,

STOURBRIDGE,

MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.
RETORTS CAREFULLY PACKED FOR SHIPMENT.
A STOCK OF DIFFERENT SHAPES ON HAND.

GAS AND WATER PIPES

AND

CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

CLAY CROSS COMPANY,

CHESTERFIELD.

TRADE	TELEGRAMS:	LONDON AGENTS:
C X C	"JACKSON"	BECK & Co.,
MARK.	CLAY CROSS.	130, GT. SUFFOLK ST., S.E.

GODDARD, MASSEY, & WARNER'S

IMPROVED

Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICES APPLY TO

GODDARD, MASSEY, & WARNER,

ENGINEERS,

NOTTINGHAM.

The Apparatus has been supplied to the following Firms–

BURT BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
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RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

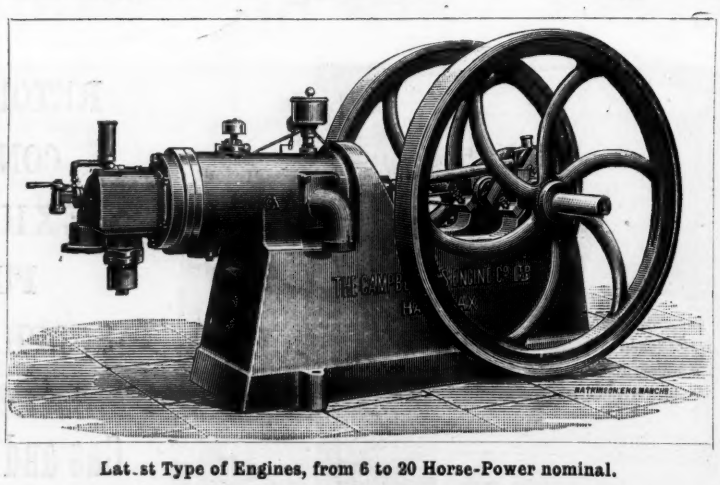
And to the following Gas Companies and Corporations–

ILKESTON.	BURY.	CHORLEY.
WIDNES.	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'.	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS.
DENTON.	SOWERBY BRIDGE.	LEEK.
ST. ALBANS.	LEICESTER.	IPSWICH.
DUKINFIELD.	DARWEN.	BOURNEMOUTH.
NORTHWICH.	NELSON.	SALFORD.
HUDDERSFIELD.	ORMSKIRK.	LUTON.
		HAMPTON COURT.

THE "CAMPBELL" GAS-ENGINE,

REDUCED

PRICES.



MOST ECONOMICAL IN GAS AND LEAST LIABLE TO BREAKDOWNS.

Latest Type of Engines, from 6 to 20 Horse-Power nominal.

Our Engines are used by Her Majesty's War Department; The South Metropolitan Gas Company, London, S.E.; at the Bedworth Gas-Works; Crossgates Gas-Works; Tiverton Gas-Works; &c.

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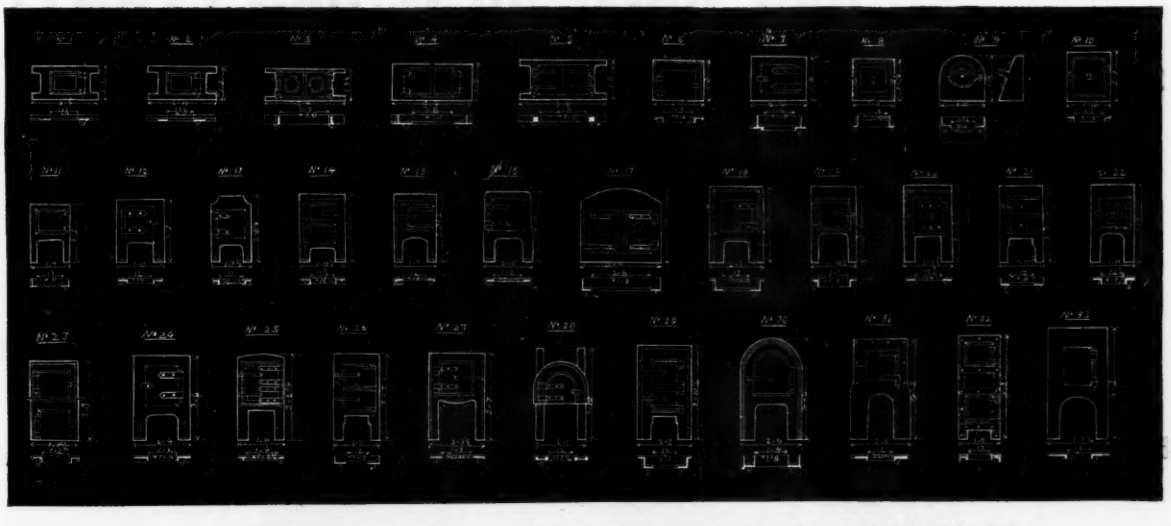

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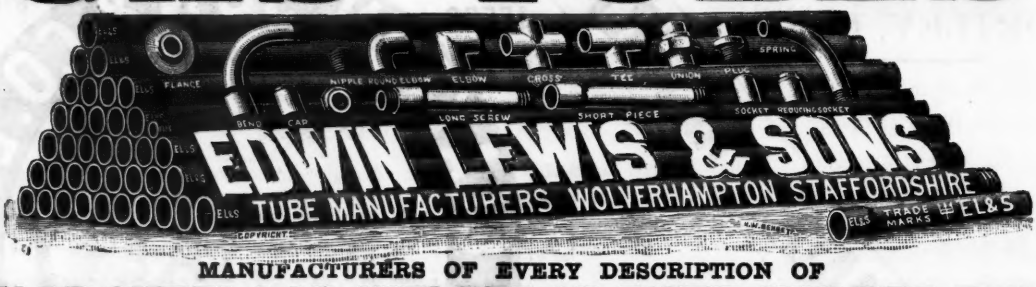

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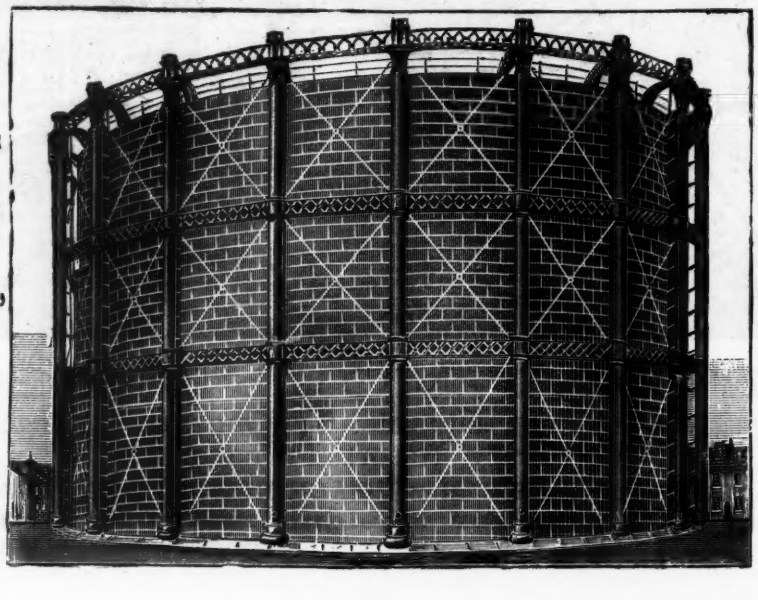

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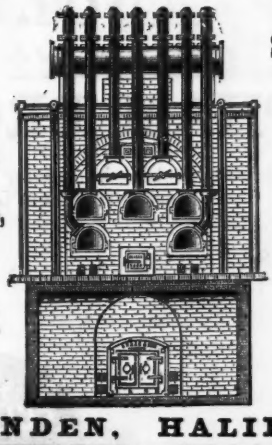

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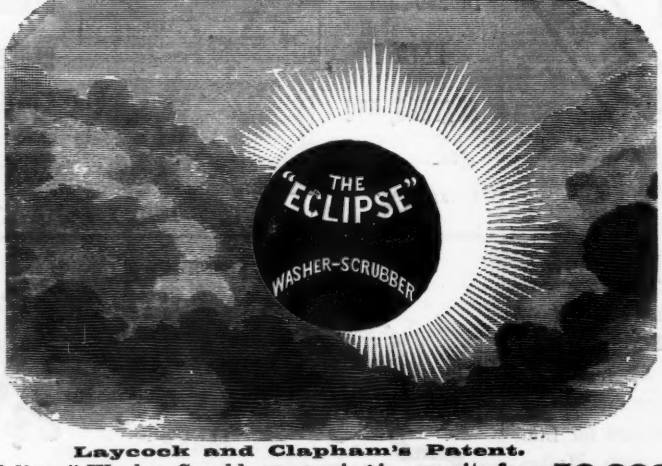

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